TECHNOLOGY DEPT.

Telephone ENGINEER and MANAGEMENT

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MARCH, 1946

featuring

GROUNDING PRACTICES IN TELEPHONE EXCHANGES
By
J. S. Reed, Jr.

•

Editorial Index page 10

•

THE COVER PICTURE—

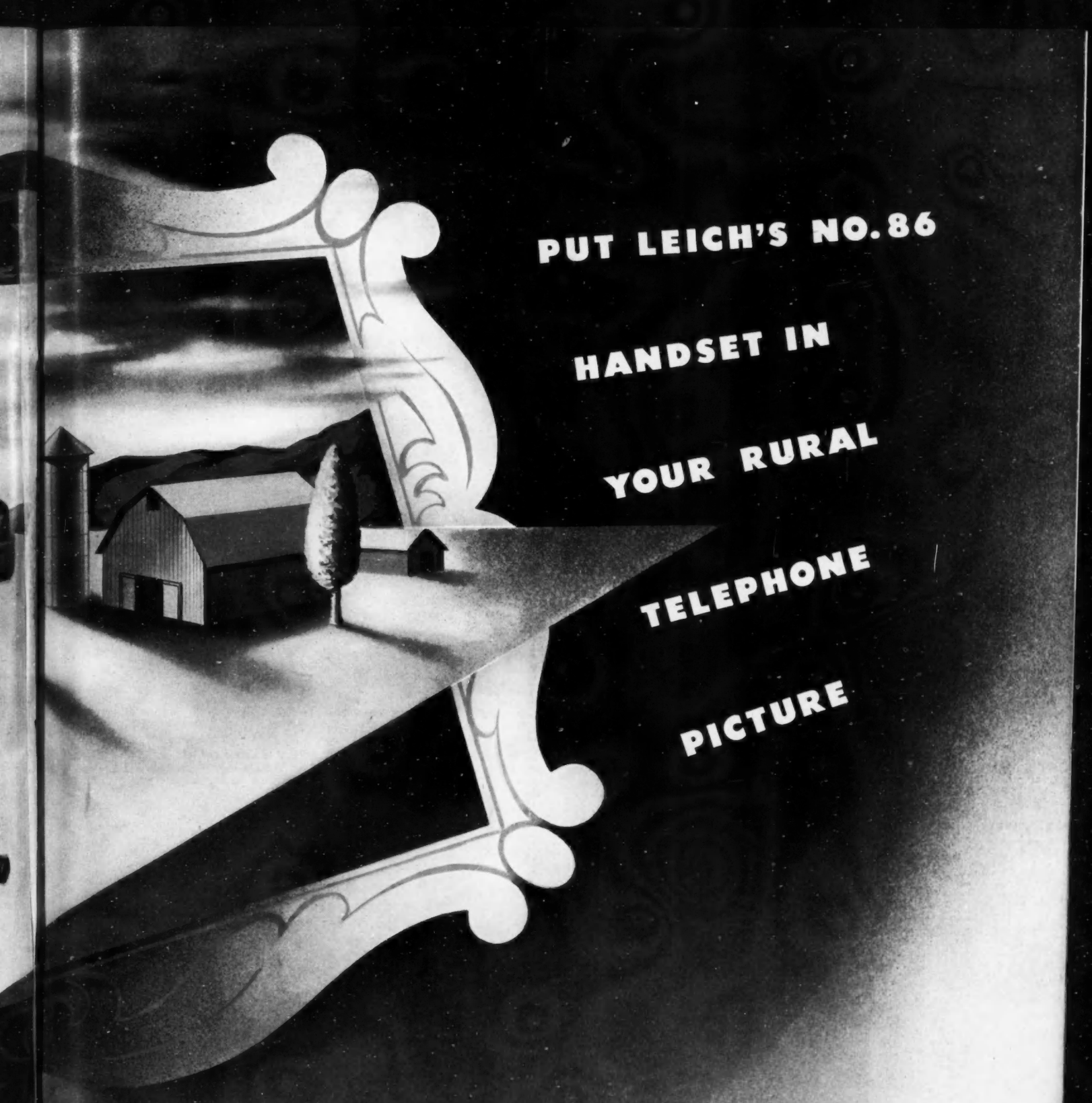
Rural carrier telephone systems may be installed in various sections of the country by the end of 1946 because of the success of trials now under way. William Hickox, Southwestern Bell installer, connects drop wires from a rural power-line carrier telephone to a coupler box mounted on an electric power pole in Jonesboro, Arkansas.

•

VOLUME 50, NUMBER 3. Published monthly by Telephone Engineer Publishing Corporation. Office of Publication, Pontiac, Illinois. Executive and Editorial Office, 7720 Sheridan Road, Chicago, Illinois. Subscription: U. S., Cuba, Mexico, $1.50 per year; Canada $2.00, in all other countries, $3.50. Single copies, U.S.A. 15 cents; single copy JANUARY 15 BLUE BOOK BUYERS' GUIDE $1.00. Entered as second class matter at the post office at Pontiac, Illinois, under the act of March 3, 1879.

THE MAGAZINE OF THE TELEPHONE INDUSTRY

LEICH
MANUFACTURERS OF TELEPHONES, SWITCHBOARDS, AND RELATED APPARATUS SINCE 1907



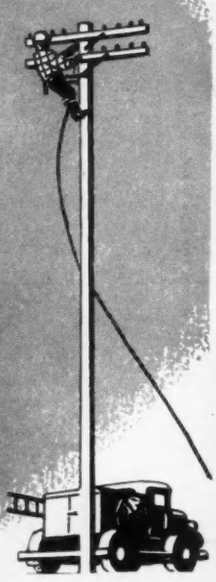
PUT LEICH'S NO. 86 HANDSET IN YOUR RURAL TELEPHONE PICTURE

As you may have noticed in an adjacent or nearby property, Leich's No. 86 handset is rapidly becoming *the* rural telephone of the day. Nor is this surprising when you consider its four-fold extra features: (1) Modern, all-molded case; (2) Full handset convenience—may be mounted at any height suitable for the user; (3) Convertible to separate desk set and generator box when this type of installation is preferred; (4) Powerful new-type Alnico generator to replace all former three-, four-, and five-bar types. Note that these are all *extra* features—in addition to the fine transmitting and receiving qualities and other sound construction details common to all Leich telephones.

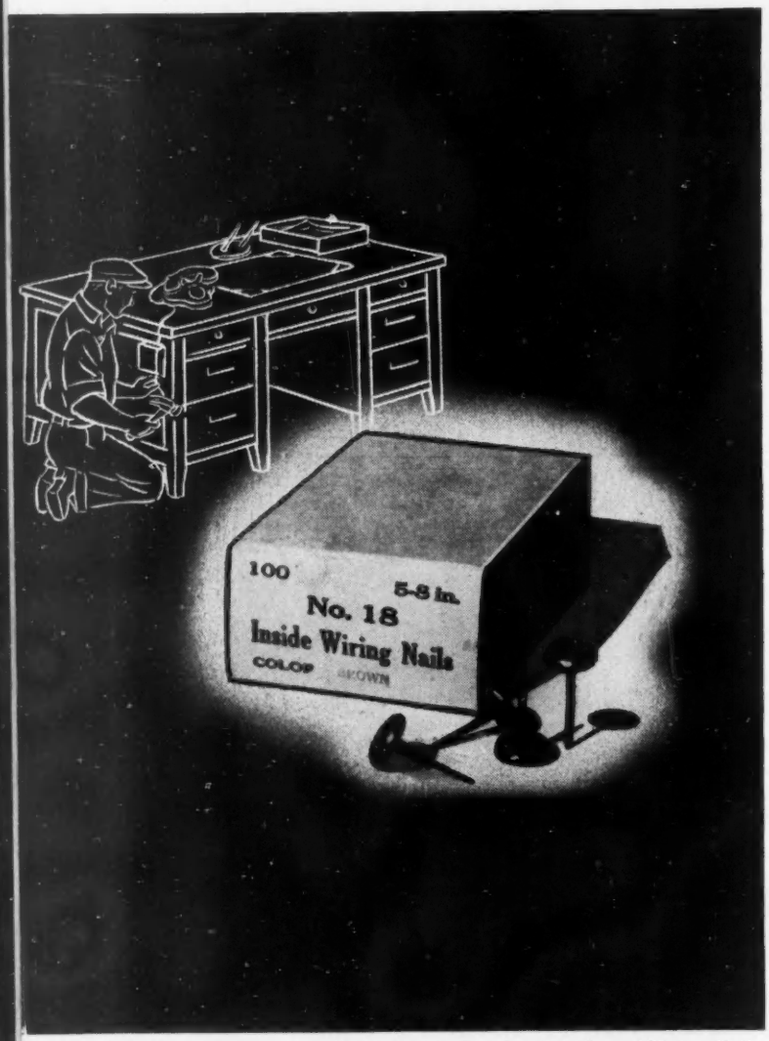
Consider the part the No. 86 can play in your rural development program. For descriptive circular, write Leich Sales Corporation, 427 W. Randolph St., Chicago 6, Illinois.

The Satisfaction Lasts When You Buy Products

Recommended and Guaranteed by KELLOGG



The Right Tool for Every Job. Follow that formula and watch your service men do better, faster work. Typical of VULCAN ELECTRIC CO.'s quality products are: Upper Left: Electric Pouring Ladle, for use with waxes, compounds, as well as for melting solder. Right: Special Wax Melting Pot. Below: No. "1700 Series" Solder Melting Pot.



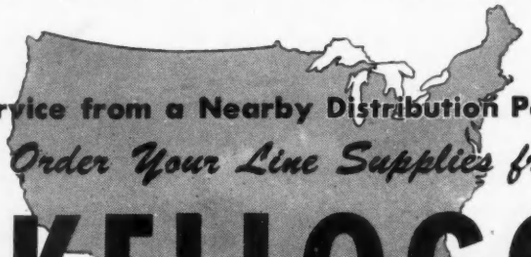
It's a Snap to make neat installations with Rhodes Telephone Wiring Nails, according to telephone men who use them exclusively. M. M. RHODES & SONS maintain the uniform high quality of these nails by means of rigid driving, withdrawing, bending and immersion tests. Available in several pin lengths and in a variety of colors to match interior color schemes.

There's three-way satisfaction when you concentrate purchases of line supply and construction materials at a single, responsible source: (1) The *quality* is right—all products are backed by the famous Kellogg DOUBLE GUARANTEE; (2) The service is right—orders are intelligently handled by experienced people; (3) *Delivery* is right—orders are shipped from the nearest of over 50 strategically located distribution points.

KELLOGG SWITCHBOARD & SUPPLY COMPANY

Branch Offices: Kansas City, San Francisco, St. Paul, Los Angeles

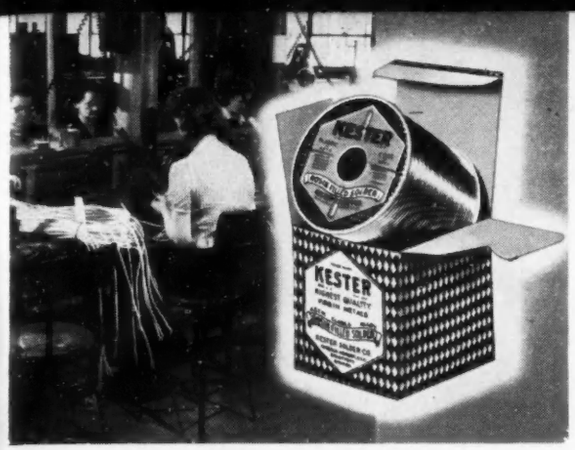
Factory and General Offices: 6650 S. Cicero Avenue, Chicago 38



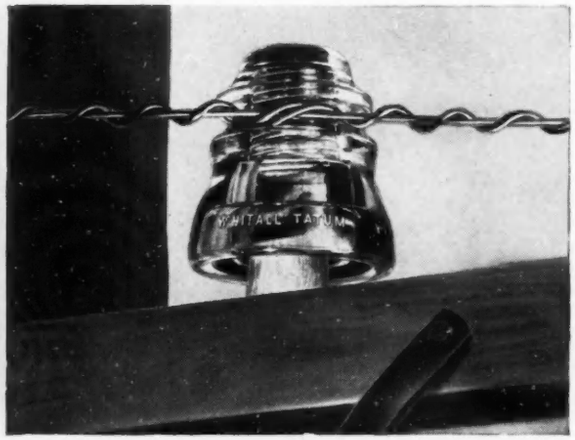
For Service from a Nearby Distribution Point

Order Your Line Supplies from

KELLOGG

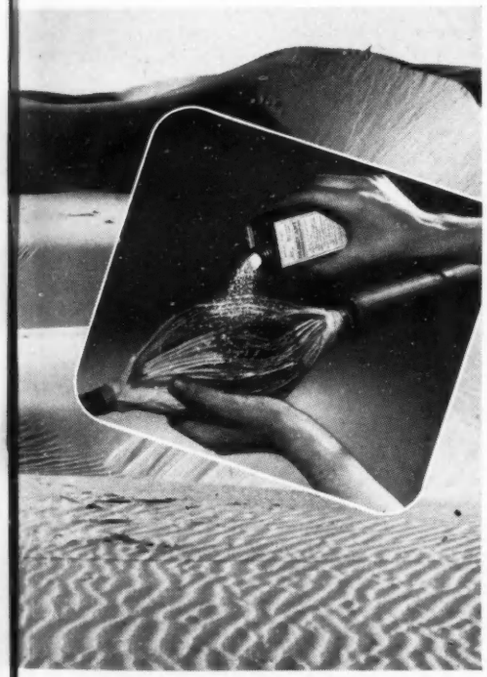


Sealed Against Trouble. Manufacturers of communication equipment insist on Kester Rosin-Core Solder for eliminating high-resistance joints and intermittent open-and-closed circuits. Remember to use KESTER SOLDER CO. Rosin-Core Solder throughout *your* telephone system.

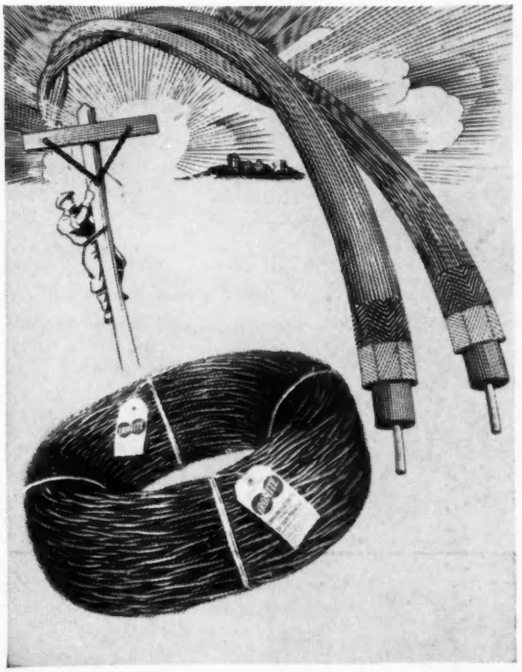


Meet Every Service Need. That's why so many telephone companies use Armstrong's Whitall Tatum Insulators. Made by ARMSTRONG CORK COMPANY, they feature crystal clarity of glass, accurate gaging, and unusual resistance to temperature changes. A good bet for reducing maintenance.

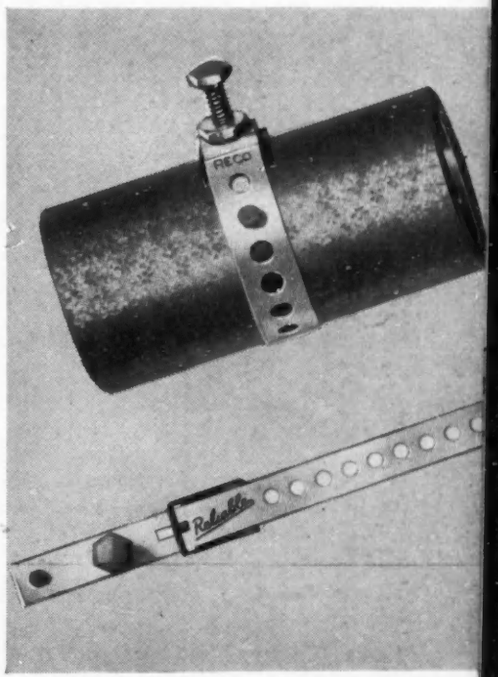
Cut Maintenance and Installation Costs with the "spinner" method of cable suspension. With the Neale Cable Spinner, made by CABLE SPINNING EQUIPMENT COMPANY, the cable and its supporting strand are lashed tightly together with a spirally applied wire. Cable hung this way will not move or vibrate. This cable suspension method has been favorably reported on by the Plant Committee of the USITA.



Drier Than the Driest Desert! The safe, easy way to dry splices in lead covered cables is to sprinkle Drierite Desiccant among the conductors. It makes the splice about the driest part of the cable. This W. A. HAMMOND DRIERITE CO. product will not harm conductors or insulation.



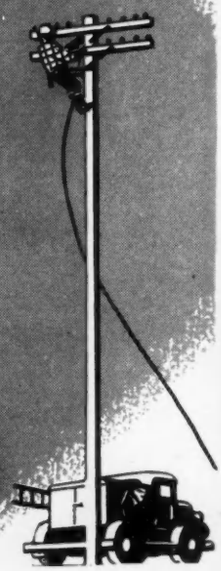
Back from the Wars. Increased quantities of Ironite Drop Wire are now available for domestic use. Made by PARAGON ELECTRIC COMPANY, Ironite has the exceptional strength to stand unusual strains with complete safety. It is "armored" for extra weather protection, highly conductive and economical.

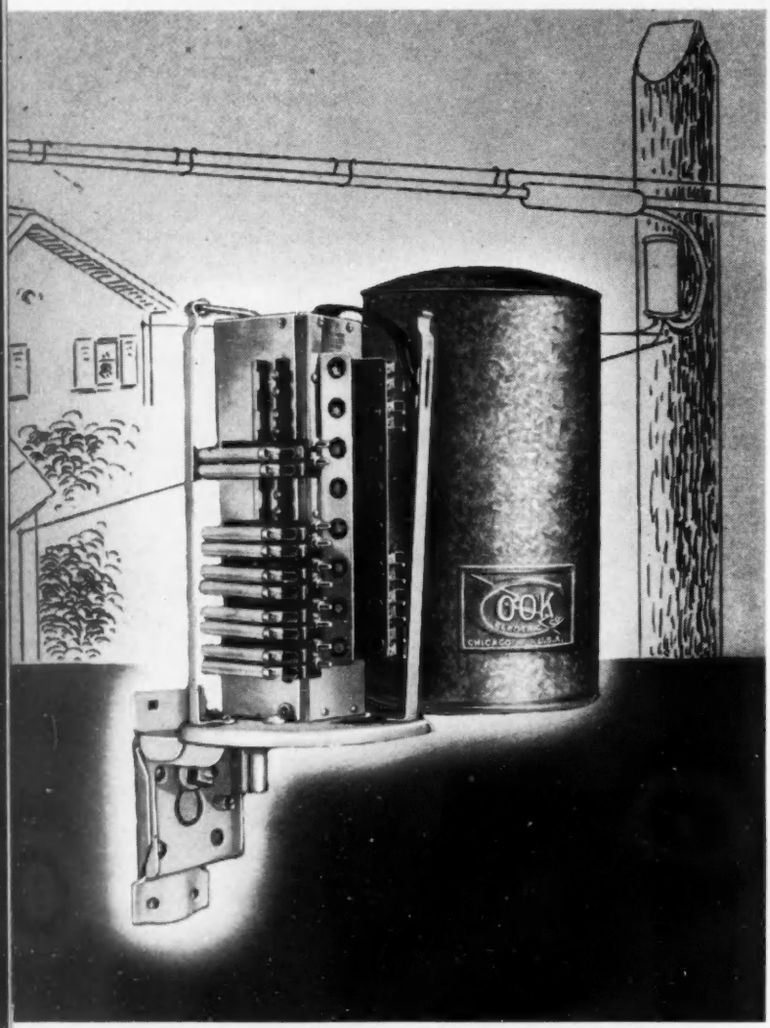


Preference Means Quality. Telephone men prefer Reliable Station Ground Clamps for telephone, radio and signal circuit station grounds employing pipes with ⅜" to 1¼" diameters. Made by RELIABLE ELECTRIC COMPANY, these quality clamps are fabricated with tinned copper strips.

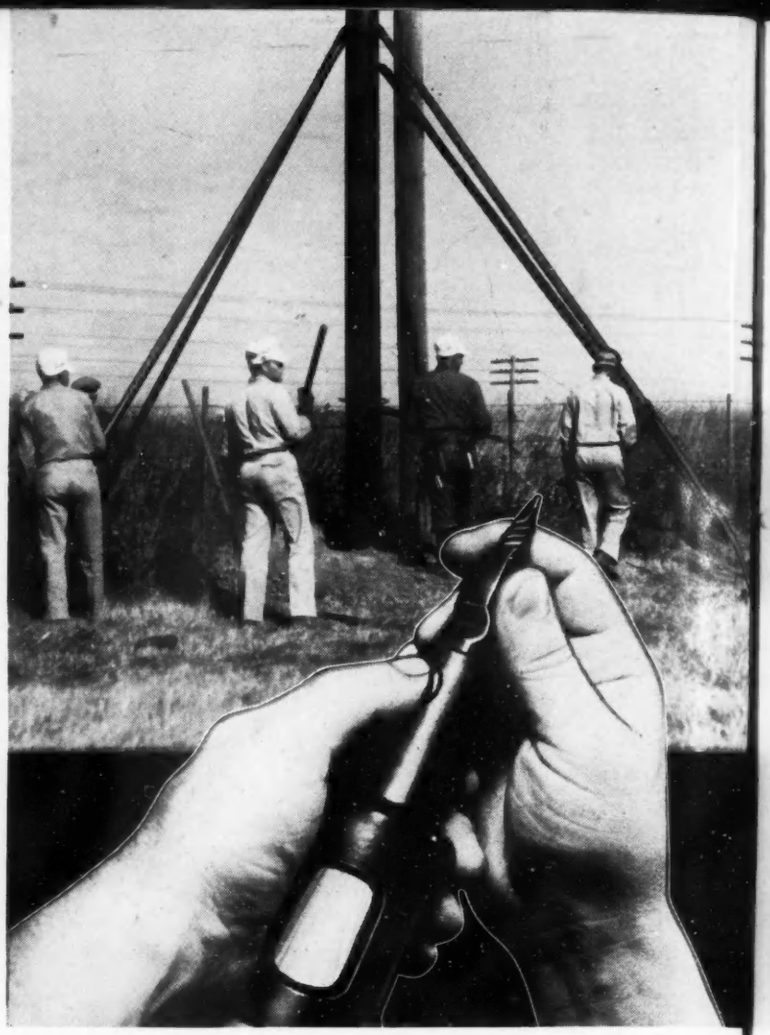
The Satisfaction Lasts When You Buy Products

Recommended and Guaranteed by KELLOGG





Convenience, Accessibility, and Economy are the outstanding features of COOK ELECTRIC COMPANY'S S-20 Pole Cable Terminal and protector mounting. Drop connections, fuses and lightning dischargers are easily reached at the front; the self-soldering nozzle lies close to the pole. A strong guide holds the hood securely in raised position for complete working ease.



Safety First! Chance Safety Pike Poles are preferred by so many telephone men because of their safety and dependability. Removable points can be inserted into the ferrule, point first, for carrying. The spiral point holds without slipping. When point becomes worn, replace point only; no need to buy a complete new pole. Made by A. B. CHANCE CO.

There's three-way satisfaction when you concentrate purchases of line supply and construction materials at a single, responsible source: (1) The *quality* is right—all products are backed by the famous Kellogg DOUBLE GUARANTEE; (2) The service is right—orders are intelligently handled by experienced people; (3) *Delivery* is right—orders are shipped from the nearest of over 50 strategically located distribution points.

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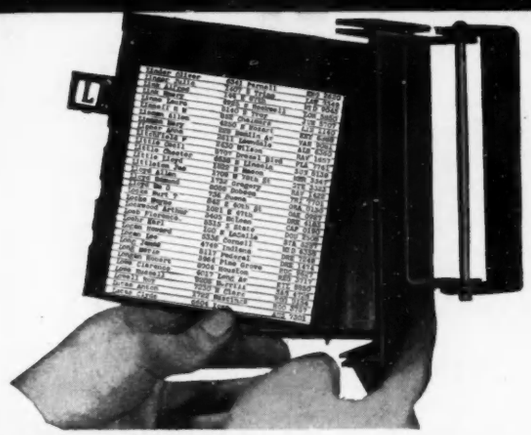
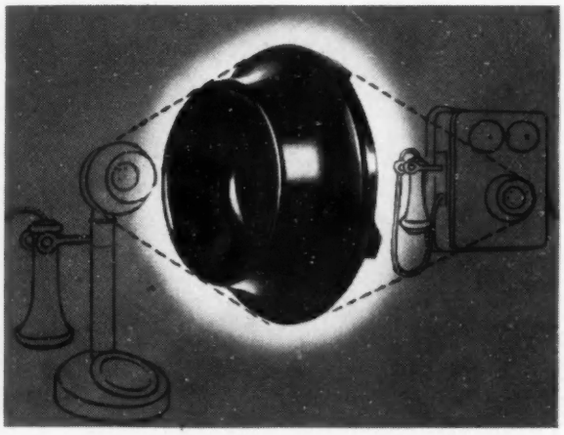
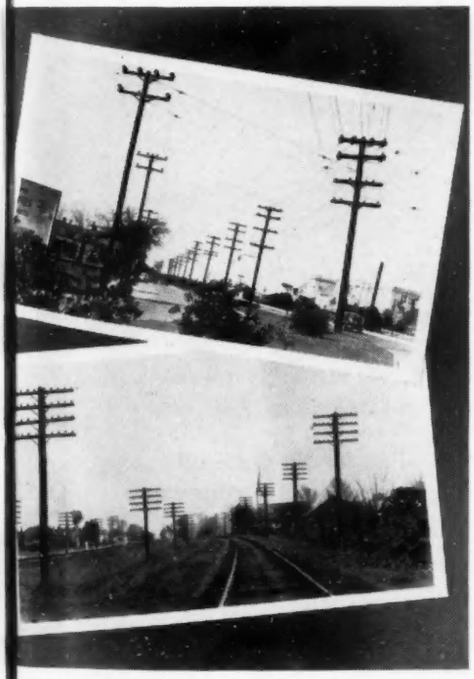


For Quick and Ready Reference. Every one of hundreds—or thousands—of subscribers names and numbers is instantly available to your operators with a "FLEXOLINE" unit. This famous time-saving product, made by ACME VISIBLE RECORDS, INC., comes in many sizes, capacities and styles.

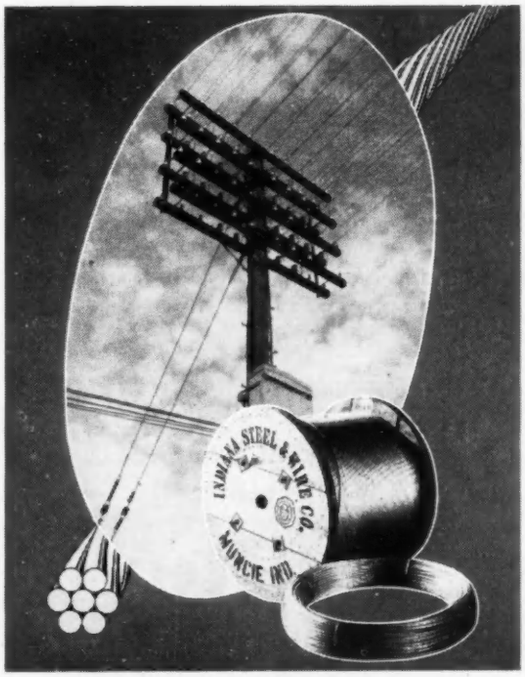


You Can Standardize on one single transmitter when you use the KELLOGG Type 121 Transmitter Front. This versatile unit takes the famous Non-Positional Handset Transmitter, makes it standard for *all* types of sets! The Type 121 Transmitter Front fits all Kellogg wall sets and desk stands.

Telephone Engineers Specify Philco Floté Storage Batteries for today's full float service. This is the only battery with special engineering, special construction and special high-efficiency grid material for full float service conditions. With PHILCO Floté on the job low cells are eliminated, maintenance and charging costs are lower, batteries last longer. To get these advantages, *ask* for Philco by name.



Long Life Expectancy is built into pressure-treated Southern Pine Poles and Crossarms. Carefully and thoroughly treated by the AMERICAN CREOSOTE WORKS, INC., these poles have the extra durability required for dependable service under the toughest climatic conditions.



The Time-Tested Steel Strand. A ductile, adherent zinc coating, applied by the famous Crapo Galvanizing Process, provides lasting protection against corrosion in Indiana Crapo Steel Strand. Made by INDIANA STEEL & WIRE CO., its rugged strength minimizes maintenance expenses and assures long life.

Eliminate Costly Service Trips necessary to replace worn-out dry cells by installing the Electrox A3V Battery Eliminator. This unit provides smooth, noise-less current for the operation of one magneto telephone and replaces the two dry cells usually used. Made by SCHAUER MACHINE COMPANY.

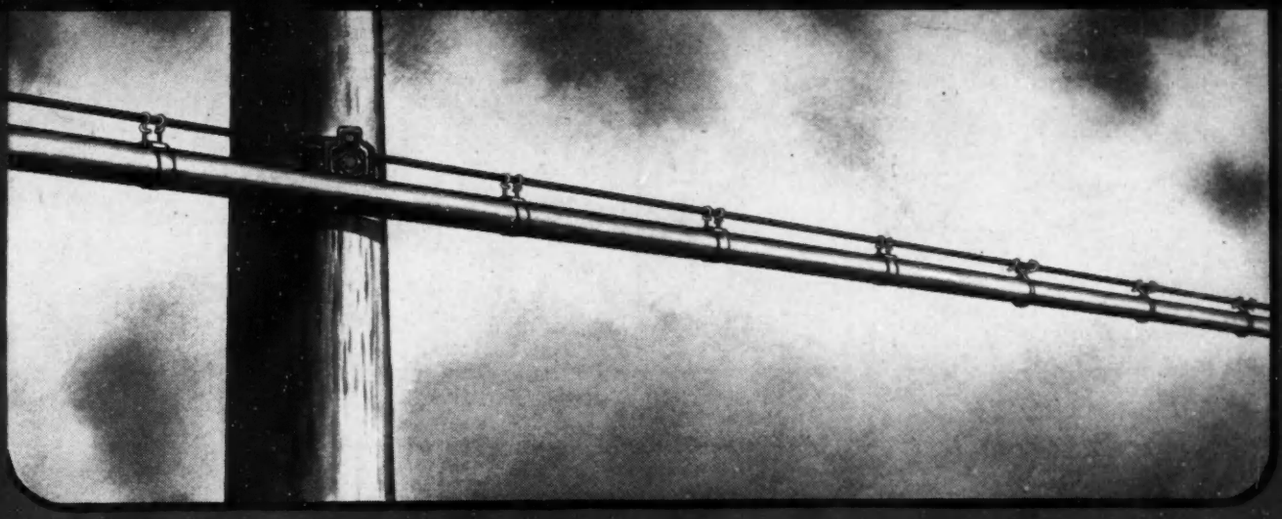
On Thursday, March 30, 1933, another engineering achievement was recorded. Direct telephone communication was established between the United States and the Philippines. Before 10 years had passed it became a wartime weapon of vital importance, and was one of the last connecting links with our island forces.

Today, telephone communication—throughout the world and at home—is being restored to the high standards of service, traditional with telephone companies throughout the years. As in the past, steady advancement continues to be a ruling factor in the telephone tradition of faithfulness and dependability.

In Exide Batteries you will find the same dependability for which telephone service is famous throughout the world. Since 1895, Exides have been proving themselves worthy of that trust.

Exide
TELEPHONE BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • Exide Batteries of Canada, Limited, Toronto



Facts about job proven method of *Cable Hanging*

● The operating experience resulting from the increased use of lead-covered cable, together with changes in the composition and thickness of cable sheath, has made it necessary to develop a more dependable method of aerial cable hanging, one that will assure a long lasting, low cost installation. We have developed such a method and recommend the practice of using a combination of National Cable Rings and Adjust-A-Straps.

Experience has shown that whenever ring cutting occurred it seldom appeared except at the first two or three ring positions on either side of the poles. By using Adjust-A-Straps at these points in place of these two or three rings, this ring cutting is eliminated.

The construction of the Adjust-A-Strap easily permits the broad strap to be tightly wrapped around the cable and also permits a full hinge motion, which allows the necessary play as the cable vibrates, expands or contracts. Its wire supports are designed to allow the cable to be lined up with the adjacent rings.

The many advantages of National Cable Rings have long been familiar to the industry. The use of National Rings makes it possible for the cable to be easily installed anywhere, whether in obstructed or congested areas or in rough country districts where lines do not follow the highway. National Cable Rings remain in position, thereby eliminating all need of reriding to replace or respace. In addition, cable can be pulled from either direction and old cable pulled out and new cable installed without reringing.

From every angle—convenience, economy and long life—this recommended "National" method of cable hanging meets all requirements. It assures a long-lasting installation that can be made in minimum time and at low over-all cost.

No tools required to hang cables the National Way

The National Telephone Supply Company

5100 SUPERIOR AVENUE • CLEVELAND 3, OHIO

Canadian Mfr.—N. SLATER CO., LTD., HAMILTON, ONT., CANADA

Export Distributor—INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N. Y.

THE NATIONAL TELEPHONE SUPPLY COMPANY

"It Seems to Us"

Harry B. MacMeal, dean of telephone magazine publishers and now sales manager of the Runzel Cord & Wire Co., Chicago is still carrying that big smile to telephone conventions. During the Texas convention it was our pleasure to introduce him to some of our old Texas friends. Because of his large acquaintance it is usually Harry who does the introducing.

•

Telephone men may be taking their lives in their hands these days, but A. S. Watson, district commercial mgr. of Pennsylvania Tel. Corp., and Lloyd Fox of the same company, think not. While they were riding peacefully along, a stray bullet from a deer hunter's gun went entirely through their car just a few feet behind them. Art Watson seems satisfied it was a stray and not directed by an impatient applicant on the company's waiting list.

•

Sergeant Earle B. Blomeyer returned from Japan late in February and is now sporting civvies again. This popular son of Mr. & Mrs. E. C. Blomeyer, Chicago, was an operating telephone executive before he entered the service. His foreign service in the Pacific theatre included Leyte and Japan.

•

N. N. Spillett, mgr. of the Brooklyn (Ia.) Mutual Telephone Co., aptly expressed the pleasure and pride every telephone company has in new equipment when he heralded the arrival of their new switchboard with announcements and a picture spread in the local paper.

•

We hear from sources "outside the field" that the Koiled Kord division of Kellogg, of which Ray Krueger is manager, is doing a bang-up distribution job—that electric appliance Kords are appearing on many merchandising counters of department and drug stores throughout the country.

TELEPHONE ENGINEER AND MANAGEMENT

Vol. 50, No. 3 **MARCH, 1946**

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Published Monthly by Telephone Engineer Publishing Corporation

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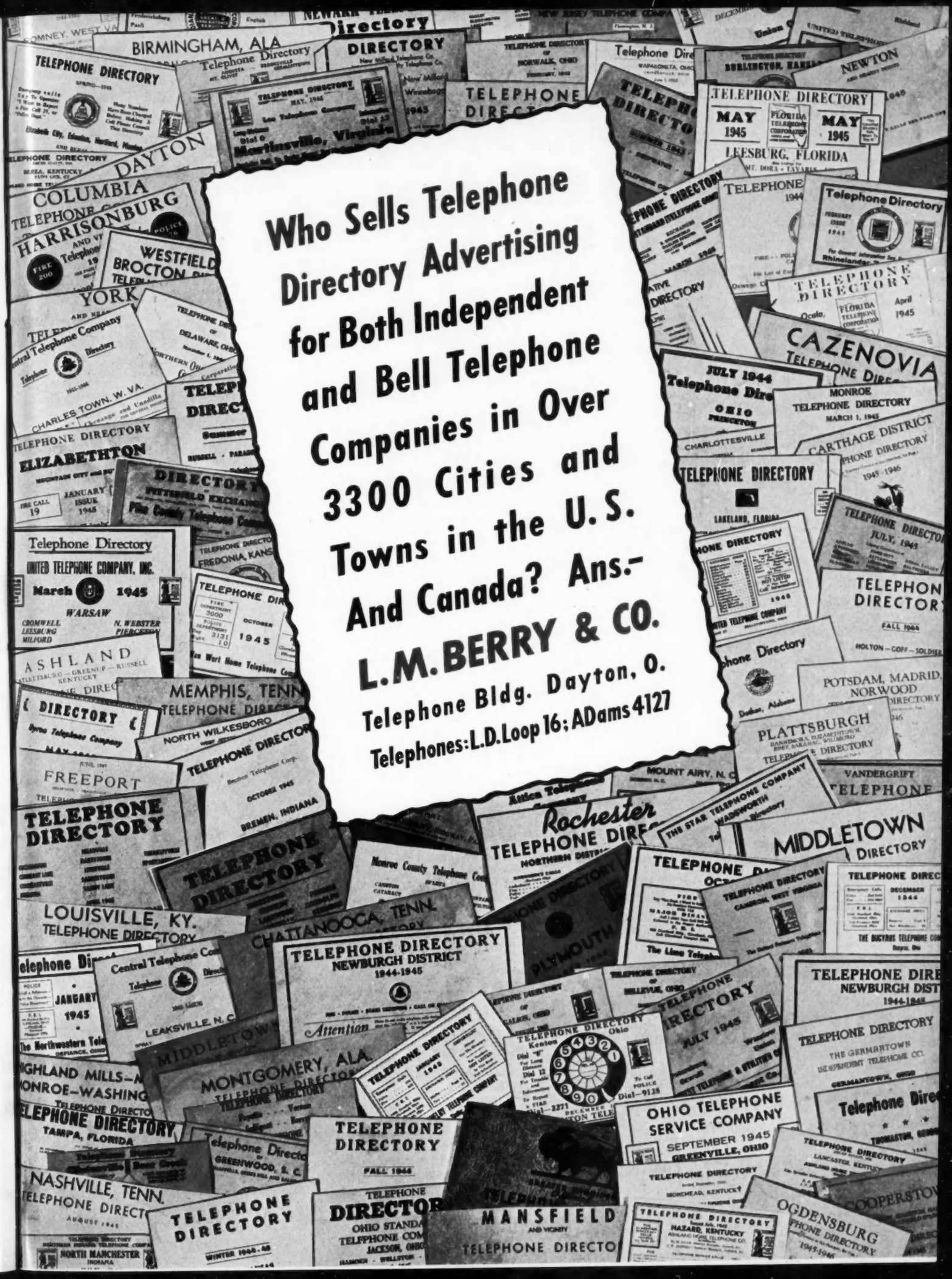
West Coast Representatives: BRAND & BRAND, 1052 W. 6th St., Los Angeles 14, Cal.

SERVING THE SIX BILLION DOLLAR TELEPHONE INDUSTRY

Founded in 1909

Office of Publication, Pontiac, Illinois. Executive and Editorial Offices 7720 Sheridan Road, Chicago 26 Illinois. Phone Rogers Park 3040. RAY W. SMITH, Editor: ROY F. SMITH, Adv. Manager, DON C. SORENSEN, Sales Prom. Mgr. Subscriptions: U. S., Cuba, Mexico $1.50 Per Year; Canada, $2.00; In all Other Countries, $3.50. Single copies, U.S.A., 15 cents. Single copy JANUARY 15 BLUE BOOK BUYER's GUIDE $1.00. All subscriptions should be sent DIRECT to 7720 Sheridan Rd. Chicago 26, Illinois.


Who Sells Telephone Directory Advertising for Both Independent and Bell Telephone Companies in Over 3300 Cities and Towns in the U.S. And Canada? Ans.-
L.M.BERRY & CO.
Telephone Bldg. Dayton, O.
Telephones: L.D. Loop 16; ADams 4127

Announcing

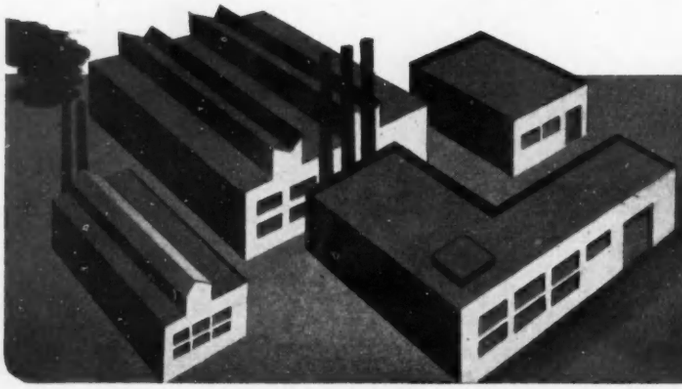
PLASTICON

A new thermoplastic insulation

THE practice of using synthetic resin compounds to insulate electric wire and cables and to protect them from injury is relatively new. Compared to other applications of plastic, this use has received little public attention; yet, there are few, if any, other fields in which plastics are solving more problems. Many the important advantages derived from the use of Plasticon for wire and cable insulation from the standpoint of installation, service, and safety are:

Because Plasticon resin compounds are efficient, economical, and permanent, it has been possible to accomplish important changes in wire design and application. Plasticon insulation is a demonstration of practical research. Its objective is to procure for the users of electricity a product that has high dielectric strength, low moisture absorption, impact strength, stability over a wide temperature range, long aging, flexural endurance, tensile strength, fungus proof, moisture resistance, and many more properties combined.

We have created a specific material, entirely new, with definite properties to meet definite needs, rather than adjusting needs to limitations of existing material.



MODERN PLANTS IN NORWICH AND JEWETT CITY CONNECTICUT

The Plastic Wire & Cable Corporation Produces Insulated Wire of Every Type

To list all the types and the sizes available in each type would take pages of space. Enough to say that all sizes are available in each of the classifications listed here — and if you have a special purpose wire not listed we have the facilities to produce it for you. Write now for complete information and samples.

- *BUILDING WIRE — from #14 stranded and solid to 2 million CM.*
- *APPARATUS WIRE — all types from 4/0 to #18.*
- *Flexible CORDS — Types including SJT, ST, SVT and POT.*
- *HEATER CORDS — all types made according to Underwriters specifications.*
- *RADIO HOOK-UP WIRES — any and all types.*
- *TELEPHONE WIRES — which includes Drop wire, Tree wire, Underground, Inside, Duct, Switchboard, Bridle.*
- *PORTABLE CABLES — diameters from #8 to 500,000 CM low and high voltage.*
- *UNDERGROUND CABLES — from 500,000 circular mils to #22 with any number of conductors.*
- *SIGNAL WIRES & CABLES — for railroad, police and fire departments.*
- *MINING CABLES and CORDS.*
- *WELDING CABLES.*
- *BUS-DROP CABLES.*
- *COAXIAL CABLES.*
- *MICROPHONE CORDS & CABLES.*
- *PUSH-BACK WIRES.*

PLASTIC

WIRE & CABLE

CORPORATION

SUCCESS STORY

- Each installation saves $30 to $90 a year.
- Trouble and expense of routine battery inspection eliminated.
- Wires carrying charging current to subscriber PBX boards are released for revenue-producing service.

Long life—outlasting many sets of batteries.

Here's how large independent telephone companies have benefited in 9 years experience with Raytheon Rectifilters.

Raytheon RECTIFILTERS

(BATTERY-ELIMINATORS FOR TELEPHONE SERVICE)

No batteries. Low maintenance. Long Life. That's the nutshell story of the Raytheon Rectifilter.

It's a success story that goes back more than nine years. A story of *proved* dependability, *proved* economy of operation, *proved* engineering excellence.

Essentially, the Rectifilter is a dry plate rectifier with associated components and a Raytheon control unit. It provides a time-tested means of supplying continuous stabilized DC voltage direct from AC. It is magnetic and automatic, requiring no adjustment, low maintenance.

Bulletin DL 48-156H gives you the rest of the story. Send for it today.

RAYTHEON

RAYTHEON MANUFACTURING COMPANY

Electrical Equipment Division, Waltham 54, Mass.

Excellence in Electronics

"TROUBLE OUT ON THE LINE"

calls for men and equipment—*fast!*

THAT'S when Highway Maintenance Bodies are most appreciated because there's a place for every tool, every needed material, and comfortable riding quarters for an adequate crew. No matter whether the trouble is on a main road or down a remote forest trail, Highway all-metal bodies are built strong to serve dependably for many years.

All tool and material compartments are *organized* for greatest convenience, for quick "get-at-ability"—because Highway's experience grows out of years of close co-operation with the leaders in this field. Highway Maintenance Bodies are light in weight, rugged in construction, with balanced design to assure correct weight distribution under all working conditions.

Other Highway equipment that has become famous throughout the industry includes Highway Earth Boring Machines, Pole Trailers, Cable Reel Trailers, Winches, and Power Take-offs. Write to us about your needs.

HIGHWAY TRAILER COMPANY

Manufacturers of: Utility Bodies • Winches • Earth Boring Machines • Pole and Cable Reel Trailers and other Public Utility Equipment.

General Offices: **EDGERTON, WISCONSIN, U.S.A.**

Every telephone man should have his own individual copy of the Big, April 15 SPRING CONSTRUCTION and MAINTENANCE issue of TELEPHONE ENGINEER and MANAGEMENT. It will be jam-packed with handy solutions of many problems you will be facing during the coming months . . . The Manufacturers and Suppliers will advertise available construction and maintenance materials . . plus . . New Products they have to offer.

If you do not receive TELEPHONE ENGINEER and MANAGEMENT, send in your subscription today. $1.50 covers a one year subscription including the big Spring Construction and Maintenance issue, 12 big issues in all.

TELEPHONE ENGINEER & MANAGEMENT
7720 SHERIDAN ROAD CHICAGO 26, ILLINOIS

DISTRIBUTED *Exclusively* BY STROMBERG-CARLSON

STURGIS METAL CHAIRS

Stromberg-Carlson is offering prompt shipments on new models of these chairs which have for so long been favorites of operating companies.

LOW CHAIRS FOR OPERATORS

The No. 876-A has an adjustable seat height from 17 to 21 inches. The back support can be adjusted easily and quickly without tools or special keys. A choice of either genuine or imitation leather upholstery is offered. The seat is 15¼″ x 16¾″ with full saddle. The frame is of 1″ tubular steel with all joints welded.

STANDARD CHAIRS FOR OPERATORS

18-22″ with footrest 5″ from floor
20-24″ with footrest 6″ from floor
22-26″ with footrest 8″ from floor
24-28″ with footrest 10″ from floor
26-30″ with footrest 12″ from floor
28-32″ with footrest 13″ from floor

HABIRSHAW WIRE

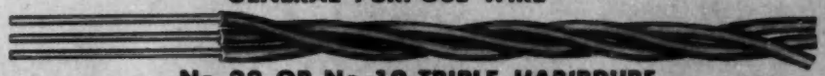
NO. 17 BRONZE PARALLEL NEOPRENE SHEATHED DROP WIRE

NO. 17 BRONZE TWISTED PAIR NEOPRENE SHEATHED DROP WIRE

Stromberg-Carlson is proud to announce these two new Drop Wires offering the following features:

1. High Dielectric Strength.
2. Flame-Resistant—Sheath will not conduct flame.
3. Weather-Resistant—No exterior braids to weather and festoon; impervious to the effects of moisture, acids, oils, and factory fumes.
4. Mechanically Strong. 5. Time-Tested.

No. 22 OR No. 19 TWISTED PAIR HABIRDURE GENERAL PURPOSE WIRE



No. 22 OR No. 19 TRIPLE HABIRDURE GENERAL PURPOSE WIRE

One stock covers requirements for inside, jumper, or duct use. Small Diameter • Clean, smooth finish • Abrasion-Resistant—No braids to fray • Oil, Acid, and Alkali resistant • Super-aging—Does not oxidize • Flame-proof—Will not support combustion • Positive Conductor Identification—Ridged markers assure identification in uncertain light • Low in Initial Cost.

It's time for CONSTRUCTION MATERIALS • Buy Yours from

Stromberg-Carlson

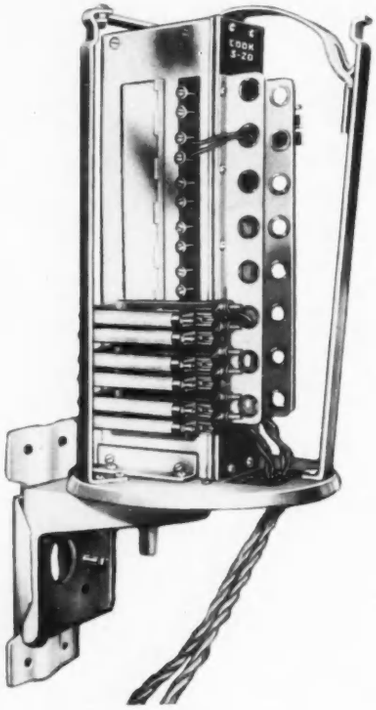
STROMBERG Telephone CARLSON

THEY'RE TESTED!

STROMBERG-CARLSON *Recommends:*

COOK TYPE O
SUBSTATION PROTECTORS

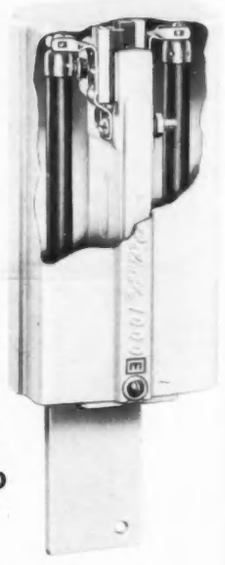
Weatherproof and fireproof. May be mounted in or outdoors.



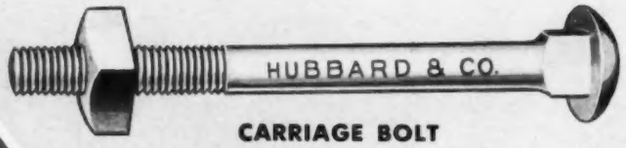
COOK TYPE S-20
CABLE TERMINALS
with H-20
PROTECTOR UNITS

Capacities 6 to 26 pair

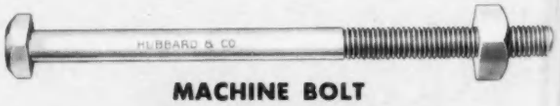
RELIABLE RU
TERMINALS



RELIABLE
TYPE 1000
ARRESTER



CARRIAGE BOLT

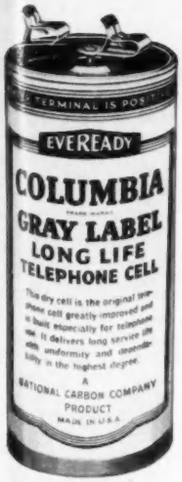


MACHINE BOLT

LAG SCREW

SQUARE WASHERS

STROMBERG-CARLSON CUSTOMERS ARE SERV BY

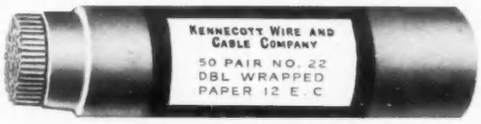


"EVEREADY"
"COLUMBIA"
"GRAY LABEL"

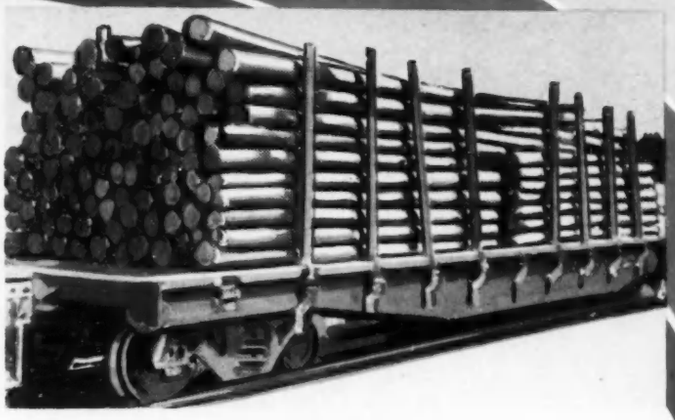
Long Life Dry Cells with Fahnestock connections. Specially designed for telephone work and light drain service.

FRICTION TAPE

HTL-85
IRON WIRE



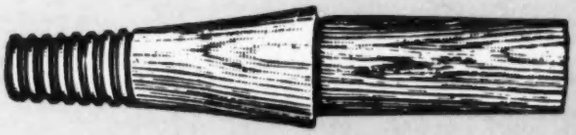
COMPLETE LINE OF CABLE



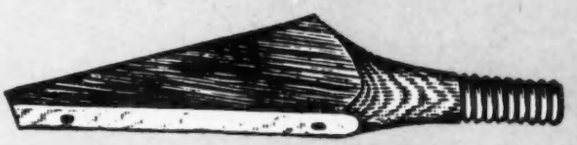
PINE POLES

Stromberg-Carlson offers a fine grade of pine poles prepared by the Rueping Process which literally pumps creosote oil into the wood cells to combat nature's attacks on pine, and which results in a thoroughly reliable pole.

INSULATED
SCREW EYES

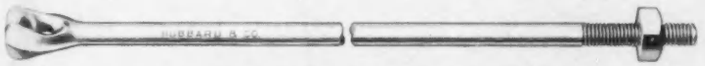


1¼" x 8" WOOD PINS



WESTERN UNION 2" x 2⅜" x 12"
OAK BRACKETS

FIR CROSSARMS



HUBEYE ANCHOR RODS

HUBEYE BOLTS

CROSSARM BRACES

STROMBERG Telephone CARLSON

BY SUPPLY DEPOTS FROM COAST TO COAST

STROMBERG-CARLSON *Recommends:*

HEMINGRAY
No. 9 INSULATOR

The exchange line pony. Standard on many telephone lines.

HEMINGRAY
No. 42 INSULATOR

Standard for many years. Its long leakage path keeps toll lines trouble-free.

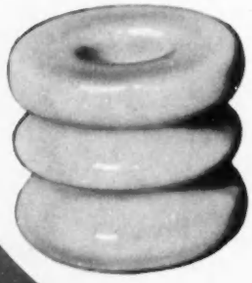
HEMINGRAY
No. 12 INSULATOR

Double groove pony provides substantial support for line wire.

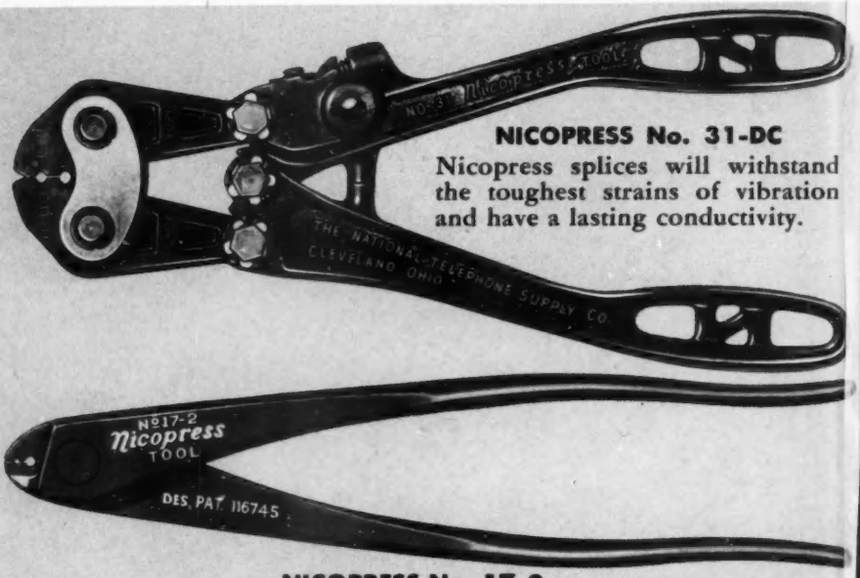
No. 6061

PORCELAIN
TELEPHONE KNOBS

Stromberg-Carlson offers telephone knobs in a wide variety of sizes.



No. 6062

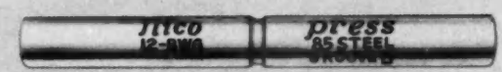


NICOPRESS No. 31-DC

Nicopress splices will withstand the toughest strains of vibration and have a lasting conductivity.

NICOPRESS No. 17-2

Convenient and practical for linemen to handle either in the air or on the ground. Pressure can be applied with the certainty that each compression will be exactly as required.



NICOPRESS No. 12 BWG Sleeves

NICOPRESS No. 17 B & S Sleeves

STROMBERG Telephone CARLSON

STROMBERG-CARLSON Factory, General Offices: Rochester 3, N.Y.

Branch Offices: Chicago 6, Kansas City 8, San Francisco 3

In Canada: Stromberg-Carlson Company Limited, Toronto

TELEPHONES, SWITCHBOARDS AND INTERCOMMUNICATION SYSTEMS • SOUND EQUIPMENT AND INDUSTRIAL SYSTEMS
RADIOS, RADIO-PHONOGRAPHS AND TELEVISION

Toll Call Starting Time
and Elapsed Time are Both
Printed *Immediately* by

Calculagraphs

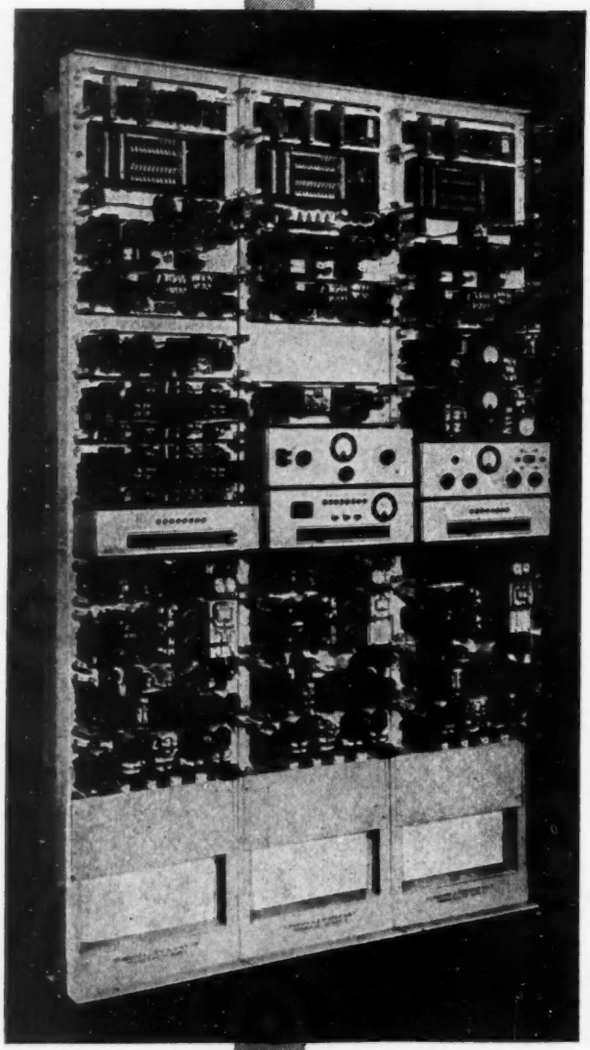
Telephone Companies
Throughout the World
Recognize Calculagraph's
Dependability

CALCULAGRAPH COMPANY

INCORPORATED 1892

310 SUSSEX STREET • HARRISON, NEW JERSEY

EXECUTIVES !



Typical Telecommunications Transmission Terminal Station.

MORE TELEGRAPH AND TELEPHONE CIRCUITS WITHOUT EXTRA WIRES

To cater for increased telephone or telegraph traffic it is not necessary to provide costly additional cable or open-wire circuits. The existing route or routes can be canalised to serve extra requirements, and the resultant transmission is superior to normal.

The equipment which renders this possible is the joint product of two Companies of repute. It is the result of years of laboratory research and close technical liaison between the transmission experts of both Companies. It can be relied upon to be the most modern development of its kind.

For telecommunications of the future you will need—

ATE TMC TELECOMMUNICATIONS TRANSMISSION EQUIPMENT

MANUFACTURERS:

Please address enquiries to—

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.
STROWGER WORKS, LIVERPOOL
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TELEPHONE MANUFACTURING CO. LTD.
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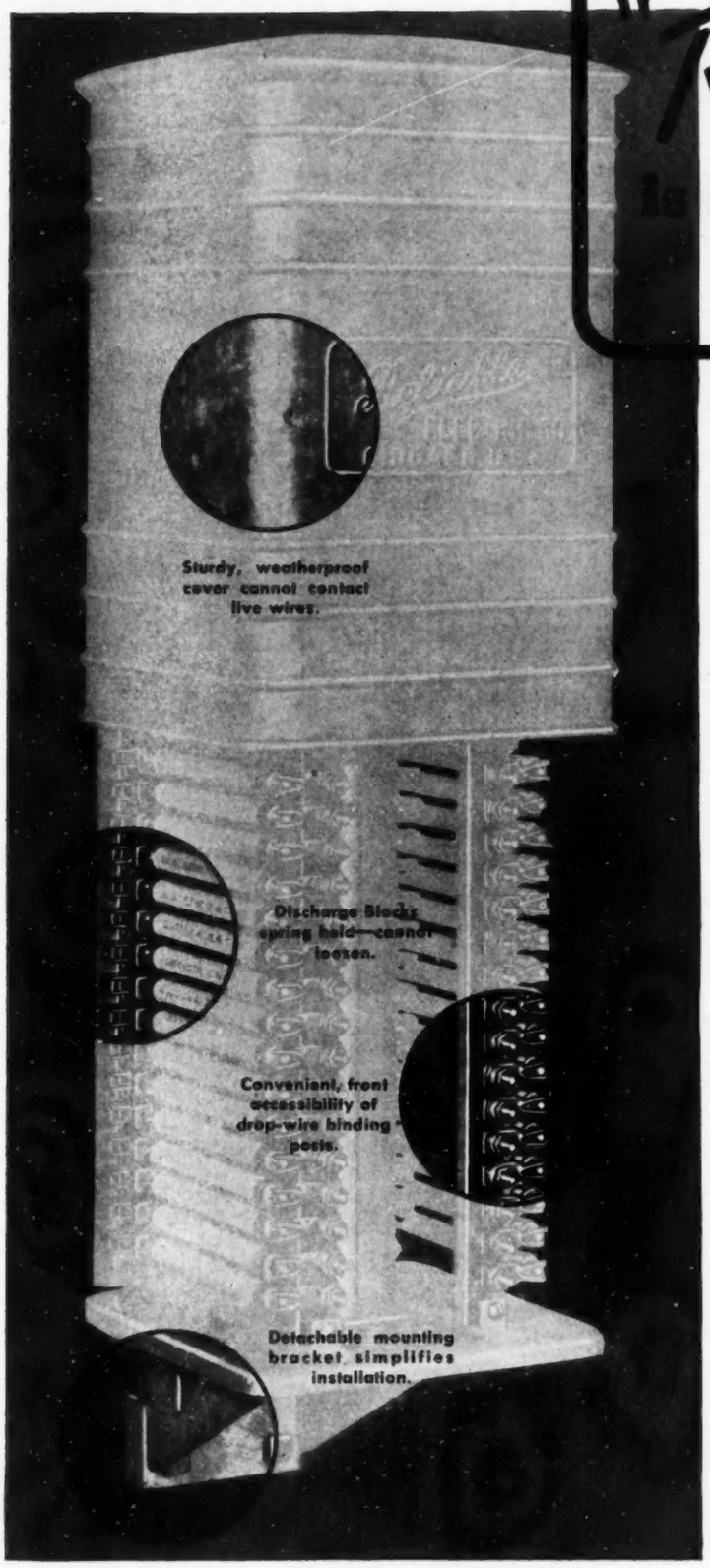
AND ST. MARY CRAY, KENT, ENGLAND

A801-A5

"Reliable"

is the word for it!


Sturdy, weatherproof cover cannot contact live wires.
Discharge Blocks spring held—cannot loosen.
Convenient, front accessibility of drop-wire binding posts.
Detachable mounting bracket simplifies installation.

A simple, conservative summary of Reliable B-Type Protector performance. This terminal is preferred for its simplicity—easy to install, easy to maintain, ruggedly constructed to outlive the cable. Proper materials and methods of manufacture, dictated by research and field experience, minimize corrosion, season cracking and other persistent evils. Reliable Self-cleaning Sawtooth Discharge Blocks are standard, dissipating static discharges without time lag or unnecessary grounding of the line. The "B" Terminals are available in 11, 16, or 26 pair capacity with type 27, 55 or 56 Reliable fuses. Code numbers are B-27, B-55, B-56.

Build for the future—specify "Reliable."

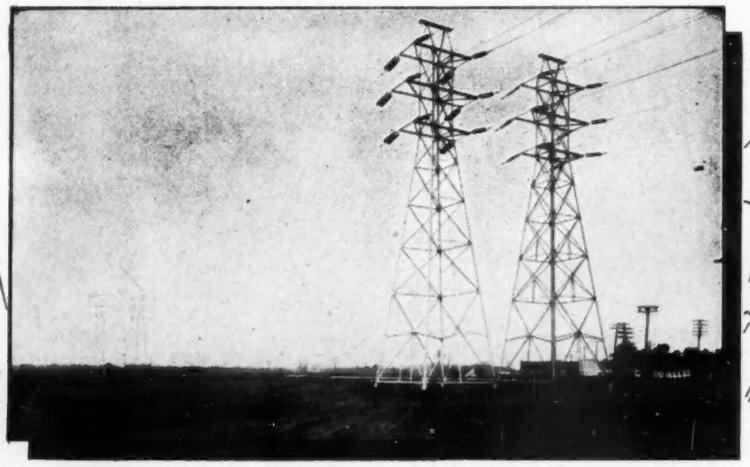
RELIABLE ELECTRIC COMPANY

3145 CARROLL AVENUE
CHICAGO 12, ILLINOIS

OVER 35 YEARS SERVICE TO THE TELEPHONE INDUSTRY

For low cost maintenance!

SPRAY YOUR WEEDS AWAY!



2-4D Dow Weed Killer

kills weeds easily - completely - chemically

2-4 Dow offers you all these advantages:

- ✓ **Harmless to ordinary grasses**
- ✓ **Doesn't sterilize the soil**
- ✓ **Higher selectivity—kills *more* weeds**
- ✓ **Easier and safer to handle**
- ✓ **Noncorrosive to spraying equipment**

At last—an easy, *chemical* way to kill weeds. Simply spray the tops with 2-4 Dow Weed Killer and kill roots and all! It's a low cost treatment that eliminates your weed problems—*and* the tiresome job of hand digging and hoeing. Does not sterilize soil or harm common grasses when used as directed.

2-4 Dow Weed Killer is the tested product you've been reading about. Use it wherever weeds must go so grass can grow—lawns, parks, playgrounds, golf courses, cemeteries and airfields. And for better maintenance—along highways, railroads and utility lines. 2-4 Dow Weed Killer is available in sizes for every need.

See Your Dealer or Write Direct!

And ask about other selective weed killers for specific purposes, soon to be announced.

AGRICULTURAL CHEMICAL DIVISION

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago • St. Louis
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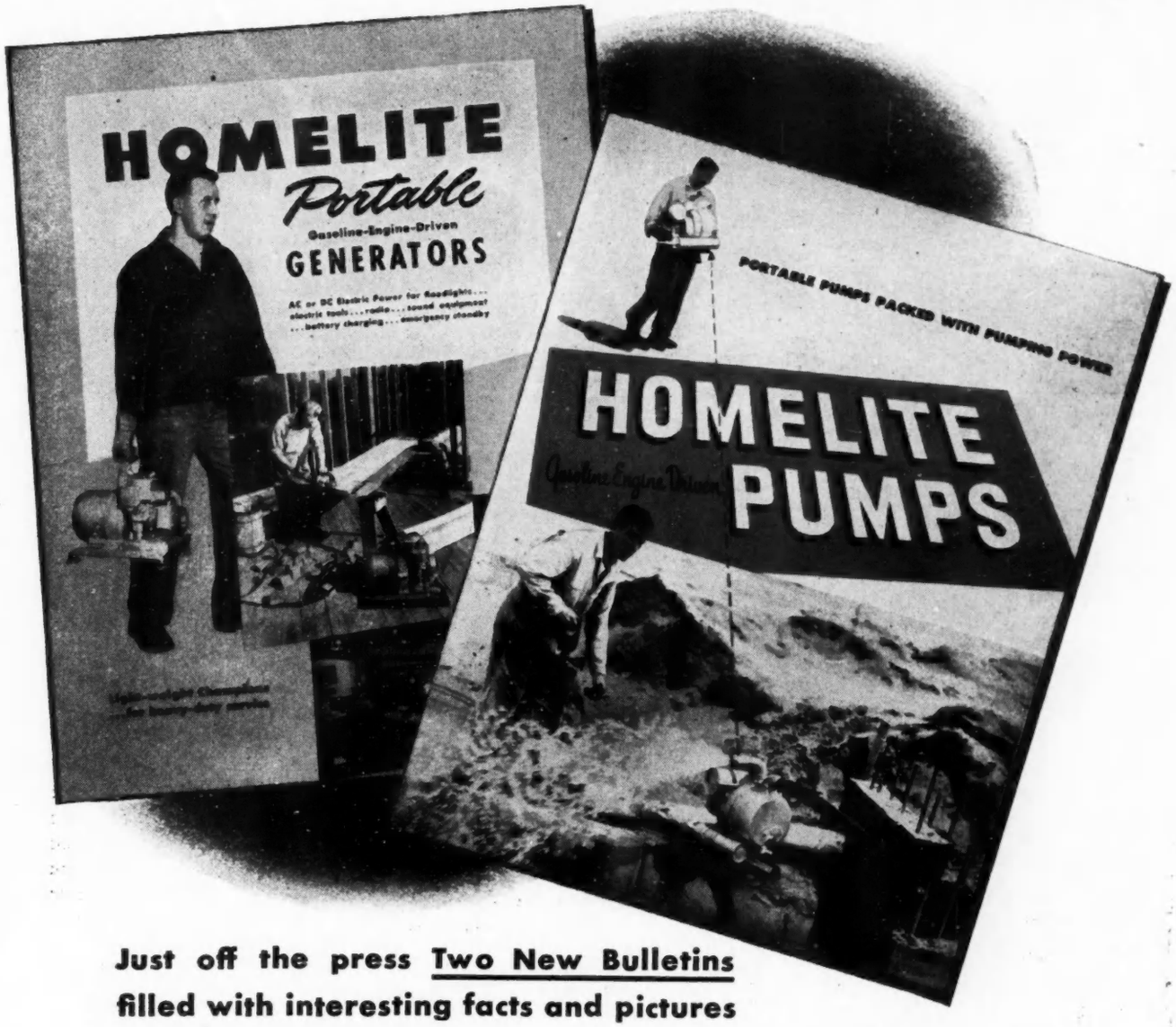
DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

Here's the Latest Information

on Homelite Portable Pumps and Generators



Just off the press Two New Bulletins
filled with interesting facts and pictures

- ★ See what these portable gasoline-engine-driven pumps and generators can do for you.
- ★ See the new and greatly improved models.
- ★ See their new light weight, capacity and output.
- ★ See the design and performance advancements that have resulted from our production of more than 200,000 Homelites for the Armed Forces.
- ★ Write for these free bulletins today. Specify Generator Bulletin L-406 or Pump Bulletin L-501.

Homelite Corporation

Portable PUMPS • GENERATORS • BLOWERS

PORT CHESTER, NEW YORK

BRANCH OFFICES

Albany, N. Y.
Atlanta, Ga.
Baltimore, Md.
Boston, Mass.
Buffalo, N. Y.
Chicago, Ill.
Cincinnati, O.
Cleveland, O.
Dallas, Tex.
Detroit, Mich.
Hartford, Conn.
Kansas City, Mo.
Los Angeles, Cal.
New York, N. Y.
No. Arlington, N. J.
Orlando, Fla.
Philadelphia, Pa.
St. Louis, Mo.
San Francisco, Cal.
Seattle, Wash.

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Pittsburgh, Pa. — C. K. Koontz Equipt. Co.
Denver, Col. — George F. Hastings
Minneapolis, Minn. — The Midwest Equipt. Co.

Canadian Representative: Terry Machinery Company Ltd.

THE ADVERTISING VOICE OF THE INDEPENDENT TELEPHONE INDUSTRY

Your Tel
Is a Farm
Your telephone is one o
friends in saving you ti
and money in your farm
it can serve you only w
working order. So, won't
handle your telephone
carefully. Treat your te
you would an important
and it will serve you we
COMPANY IMP

THE PICTURE'S IMPROVING
Our postwar promise to you was up-to-the-minute service made available for all who want it. We will make good on that promise just as quickly as possible. Some progress has already been made in that direction. It will increase with time. You can count on your telephone company to provide the type of service that will speed our community's postwar program and prosperity.
COMPANY IMPRINT

★ The Telephone Advertising Institute offers a sound, intelligently planned advertising and public relations program, prepared under direction of the USITA Advertising Committee. Designed to help create immeasurable good will and future business . . . this program also enables the public to better understand the problems of the telephone company. The use of Telephone Advertising Institute material by more than 875 Independent telephone exchanges is convincing proof of its effective coverage of the advertising needs of the entire Independent telephone industry.

A year's subscription entitles you to the following:

- **52 newspaper mats**
- **12 colorful posters**
- **24 effective booth and counter cards**
- **News releases**
- **Radio continuity**
- **Direct mail pieces and bill inserts at nominal cost**
- **Telephone Advertising Digest—clearinghouse of ideas and information**

In addition, special material is prepared at low cost; and the Institute's services are available to help suscribers with individual advertising problems.

Here is the very low cost of complete program with the finest in ideas, artwork, typography, engraving, etc.:

Per exchange	Per Month
500 to 999 telephones	$ 1.50
1,000 to 1,499 telephones	2.00
1,500 to 2,499 telephones	3.00
2,500 to 4,999 telephones	5.00
5,000 to 9,999 telephones	10.00
Over 10,000 telephones	20.00

Companies with one or more exchanges, none of which operate more than 500 stations, may subscribe to the TELEPHONE ADVERTISING DIGEST at $3.00 per year and be entitled to purchase individual items at quoted prices; or may subscribe for each exchange at $1.50 per month and receive complete service.

The Institute representative will be present at most of the coming state telephone conventions. Those who have not taken advantage of this effective, economical service are urged to talk to the representative at these meetings or write the Institute for further information.

TELEPHONE ADVERTISING INSTITUTE
326 West Madison Street, Chicago 6, Illinois

EDITORIAL

Must We Have Politics in Regulation?

WHEN, in these times, a regulatory commission calls all the telephone companies under its jurisdiction into a formal hearing to explain why they have not installed new equipment or otherwise improved their service since V-J Day, and how soon they are going to do it, there must be some reason for it other than the commission's desire to get information.

Surely, some commissioner on every regulatory commission, or some member of every commission's staff, has heard something, somewhere, about what has been going on in this country since V-J Day; particularly what has been going on in the way of strikes, reconversion difficulties of manufacturing companies, shortages of many materials—including the vital material of steel—and the lack of skilled manpower for highly technical manufacture.

It is common knowledge in the telephone industry — and should be also in commissions alert to the situation of the industries they regulate—that telephone companies are clamoring for equipment, particularly telephone instruments, and that manufacturers are using all their ingenuity and available facilities to fill orders as promptly and as completely as possible.

The United States Independent Telephone Association and the Independent manufacturers have taken cognizance of the situation to the extent of meeting together and working out a system of cooperation between operating companies and manufacturers, designed to speed equipment relief for urgent operating situations and to fill all new equipment needs as soon as that can possibly be done under existing and prospective conditions, with special emphasis on taking care, first, of "held order" applications for telephones.

(A statement issued by the Association on this matter is printed in full on page 75 in this issue.)

Of course the commissions are receiving complaints about the telephone situation; particularly complaints from people who want telephones. The telephone companies are receiving such complaints, too.

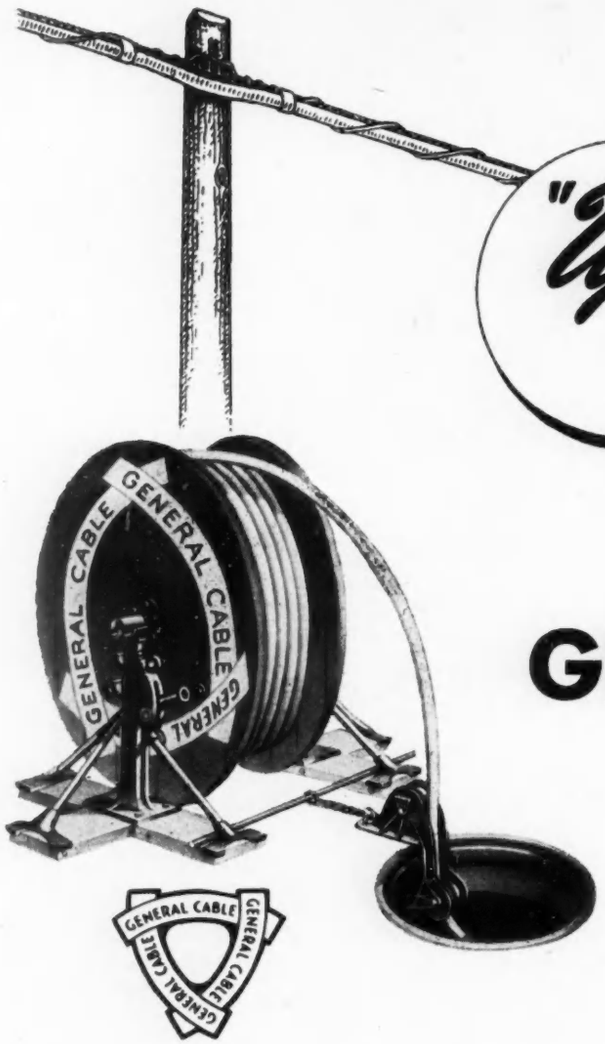
It seems obvious that the best and fairest way to deal with such complaints, whether received by commission or company, is to tell the complainant frankly what the situation is, and that it is one brought about by war conditions and beyond the present control of either comissions, companies or manufacturers.

We doubt if holding hearings on the matter will produce a single switchboard or telephone sooner than they would otherwise be produced. We think, also, that all the information any commission wants about this present condition can be elicited from the telephone companies just as well and as quickly—and a great deal more economically as to money and time—by the less formal methods of mail or telephone conversations.

This publication has always been, and is, sympathic to the difficulties of the regulatory commissions—who have their troubles, we know. We have, upon more than one occasion, expressed our appreciation of the cooperation given the telephone industry by the commission during the war.

That cooperation worked well, and without injustice to the public. It also worked with a minimum of politics.

We think that telephone companies are entitled to hope that this minimum of politics will continue—at least during the time the companies are so busy with the job of restoring their service to its prewar standards.



"Up in the Air" or "Down Under"

GENERAL CABLE

Quality Pays

● Whether your plans call for aerial or for underground installation, you can count on General Cable quality and workmanship to reduce repairs to a minimum. General Cable's wide line assures you of just the right cable for your specific need—a cable that is durable and practically trouble-free.

Backed by a half-century of experience, the finest of materials, and craftsmen working with the most modern machines, General Cable offers you the best in quality and service.

General Cable can be supplied for any aerial or underground requirement; so when you buy cable, be sure you get the protection of General Cable quality. Turn to your big Automatic Electric catalog for complete cable specifications and ordering information.

MANUFACTURED FOR

AUTOMATIC ELECTRIC COMPANY
By GENERAL CABLE COMPANY

RECOMMENDED AND DISTRIBUTED BY

AUTOMATIC ELECTRIC
SALES CORPORATION

1033 WEST VAN BUREN STREET, CHICAGO 7, ILLINOIS

NEWS Briefs...

New Company Follows Rate Increase

The Farmers & Merchants Union Telephone Company, Milton, Iowa, is being organized and will seek a franchise in the Milton election this month.

The action follows rate increases announced December 1 by the Middle States Utilities Co., of Iowa, which has been operating in Milton without benefit of a franchise.

The new firm, organized as the Farmers and Merchants Union Telephone Co., will have A. M. Brady as president, O. E. Rowland vice president, Richard Brown secretary and J. A. Luman treasurer. F. R. Glasgow and Fred Short are also directors.

Seventy six of the 186 subscribers on the Middle States Co. exchange here were reported to have ordered service discontinued following announcement of the rate increases. At that time the monthly rate for private telephones was reported increased from $1.76 to $3.81 and the rate on business phones hiked from $2.34 to $5.27, all figures including taxes.

A letter to subscribers from W. M. Butschy of Leon, district manager, said the increases were necessitated by increased costs of operation.

To Issue Stock

The Central Telephone Company with home offices in Sioux Falls, S. D. has received authority from the North Carolina Utilities Commission to issue 5,000 shares of $2.50 Cumulative Preferred Stock, Series A, without par value, but with a stated value of $50 per share, up until April 6, 1946.

The issuance of the securities is for construction, extension and improvement of Central Tel.'s property and service.

Authorizes Carrier Project

The addition of 180 channels for long distance telephone service for various routes between Atlanta and Chicago, St. Louis, Cincinnati, Nashville and Memphis, and between Chicago and Memphis and Terre Haute was projected in a $1,049,000 toll construction program for installing carrier systems, which was approved by the FCC Feb. 20 for the American Telephone & Telegraph Co., and Illinois Bell.

The 180 new channels would be provided by the installation of 12 Type "K," 2 "JK" and one "J" carrier systems with a Type "C" carrier equipment at Nashville to be removed.

There will be 48 additional telephone channels between Atlanta and St. Louis, and Atlanta and Chicago; 24 added channels between Atlanta and Nashville; 12 each for Atlanta-Memphis, Atlanta-Cincinnati, Chattanooga-Knoxville, Chicago-Memphis and Chicago-Terre Haute.

Charter Granted

The Farmers Telephone Company of Rozel, Kansas, was granted a charter last month and was organized under the state's cooperative association statutes. It will operate its exchange to cover parts of Pawnee and Edwards Counties, Kansas.

Sale

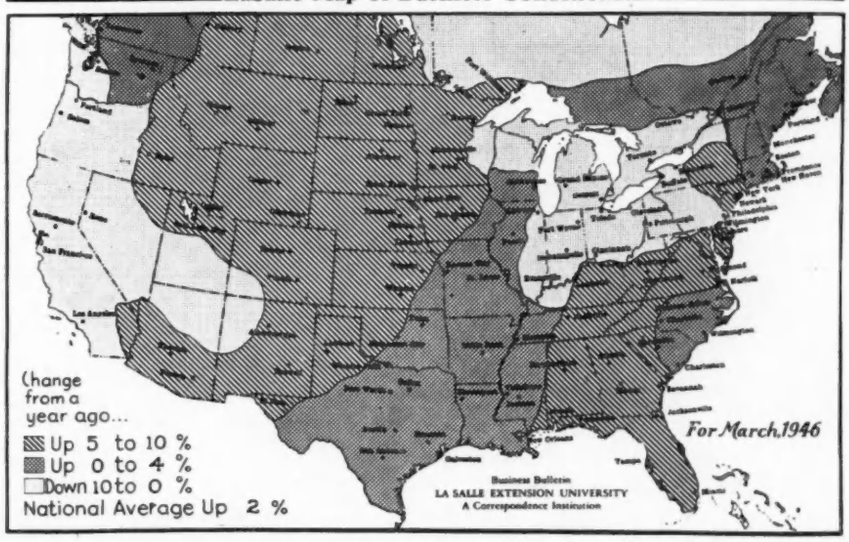
The Farquar Telephone Company, operating in Canyonville and Riddle, Oregon and owned by R. J. Farquar, is being purchased by Wendell E. and Vera L. Boggs for $6,000. George H. Flagg, public utility commissioner of Oregon, authorized the sale Feb. 21.

Report on Radio in Telephone Field

The USITA will issue about March 15 a 44-page booklet titled "Report and Recommendations on the Use of Radio in the Telephone Field." This booklet specifically recommends that companies able to do so engage in a program of radio experimentation. This effort on the part of the USITA to encourage its members to engage in radio will be an opening gun in the campaign to encourage Independent companies to take full advantage of the wartime development in the radio field.

The report is being prepared for the Association by B. C. Burden, consulting engineer, Lincoln, Nebraska in collaboration with the Plant and Commercial Committees of USITA.

LaSalle Map of Business Conditions


Change from a year ago...
Up 5 to 10 %
Up 0 to 4 %
Down 10 to 0 %
National Average Up 2 %
For March, 1946
Business Bulletin
LA SALLE EXTENSION UNIVERSITY
A Correspondence Institution

Business is still above last year in many places. The major industrial regions have been affected most adversely, but operations have been depressed somewhat elsewhere, the LaSalle analysis reports for March. The total volume of business which includes both industrial production and commercial transactions has remained 2% above even the high level of a year ago. Retail trade and service industries have largely offset the decline in factory output.

GROUNDING PRACTICES

in Telephone Exchanges

By J. S. REED, Jr.

INTENTIONAL or "made" grounds are indispensable to the proper operation or protection of telephone circuits. Such grounds are made at the central office to protect the equipment and to provide a connection to earth for ringing current in divided ringing systems. At the subscriber's station, a ground connection is used for ground return of ringing current and for protectors to by-pass to earth, for high voltage currents resulting from line crosses, and lightning discharges. Ground connections are also made at certain points in a telephone line for protective purposes.

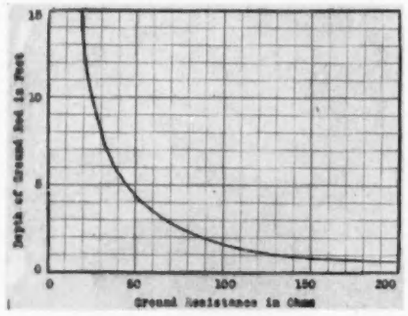


Fig. 1—Variation of ground resistance with depth to which ground rod is driven.

There is no question as to the need for well made grounds. Telephone men are perfectly aware of the fact that a ground that has gone bad whether as the result of improper grounding methods or other causes can result disastrously. Besides causing poor ringing where grounded ringing is utilized, dangerously high voltages may result due to the high resistance of the ground when a high potential cross or a lightning discharge occurs. This may be manifested by the complete distruction of the protective equipment and the line wires and the firing of the surrounding property with resulting damage. A poor ground at a subscriber's station is often the cause of the metallic conductors of a drop wire being completely vaporized by a lightning discharge, leaving rubber and braid coverings intact except for pin holes at intervals along the length of the drop wire.

This article discusses factors affecting conductivity of grounds, the theory underlying grounding, measurements of ground resistance, and methods of installing grounds.

Factors Affecting Conductivity of Grounds

Since a ground must have low resistance in order that telephone circuit and protective equipment may function properly, we shall analyze factors influencing the conductivity of grounds. These factors are the following:

1. Availability of existing permanent low resistance grounds.
2. Length and number of ground rods installed.
3. Resistance of ground path itself.

A permanent low resistance ground is most easily obtained by connecting the ground lead to a water pipe; provided that the pipe is part of an extensive water supply system. Con-

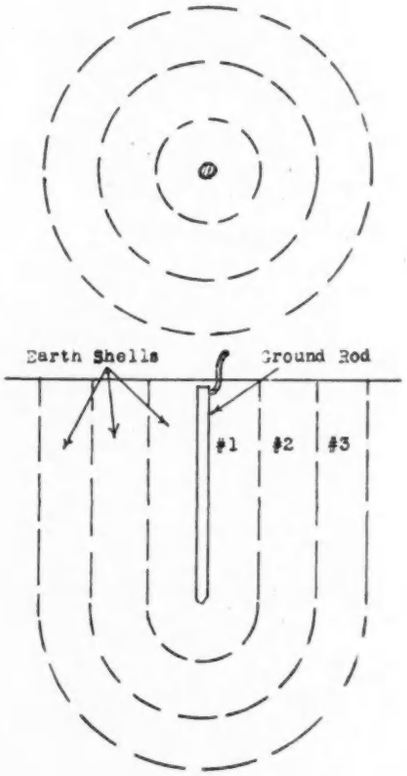


Fig. 2—Illustrating the concentric shell theory.

nection to a private water supply system should be avoided for the reason that a rubber hose coupling is often placed in the piping at the pump to reduce the transmission of vibration from the pumping equipment. Water alone is a poor conductor and would offer high resistance to the passage of ringing current, or, worse still, to the passage of high voltage or lightning discharges.

Even if a direct connection can be made to the supply pipe from the well the pipe may not be in sufficient contact with the earth to make a good ground connection on account of its short length. In case of wells with metal casing, a satisfactory ground can be obtained by connecting the ground wire directly to the casing.

In case of doubt as to the suitability of a water supply system for grounding purposes, it is usually better to install one or more ground rods as required to secure a low resistance connection.

Effect of Ground Rod Dimensions

The length of a ground rod has a definite effect on the conductivity of the ground. From Figure 1 it can be seen that the resistance of a ground goes down with the increase in the depth to which the rod is driven, up to a certain point. Beyond this point, depending on the condition of the soil and other factors, it does little good to drive the rod any further, since only a slight decrease in the resistance results. For most substation installations, the use of a five- or six-foot rod will result in a good ground resistance of from 40 to 60 ohms in moist soil.

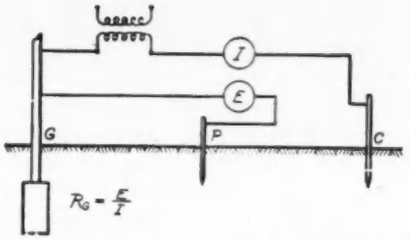


Fig. 3—Illustrating the fall of a-c potential principle.

The diameter of the ground rod is usually of little consequence as far as the total ground resistance is concerned. This diameter need only be as small as practicable consistent with driving ease. If the rod is too thin, it will bend when pushed into the soil or whip badly when pounded with a hammer. Of course, a thin rod is much easier to push into the ground than a heavier, thicker rod. Most telephone companies use ⅜ inch or ½ inch ground rod, though we know of one company that utilizes ¼ inch copperweld rods with highly satisfactory results.

The material of which the ground rod is composed has no appreciable influence on the conductivity of the ground. Any kind of metal can be utilized for grounding purposes as long as it is not coated with non-conducting substances such as paint asphalt or grease. Galvanized iron or copperweld rods are quite satisfactory for making grounds. If an iron ground rod is rusty from long contact with the earth, no harm is done as long as the soil is sufficiently moist. The rust (iron oxide) coating is electrically conductive when wet.

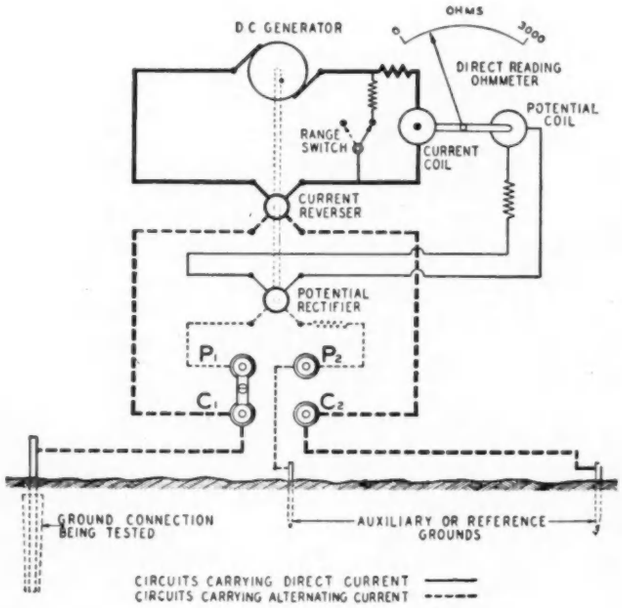


Fig. 4—Showing how a meg or megger type ground tester operates.

Drawings Courtesy James G. Biddle Co.

Multiple Grounds

Multiple grounds are employed when it is desired to obtain an extremely low resistance ground and extensive water supply systems are not available to provide the low resistance connection desired. If hard pan is encountered a short distance below the surface of the soil so short rods would have to be used, or the soil is high in resistance, connecting three or more driven grounds in multiple will greatly reduce the ground resistance. The ground rods should be 6 to 15 feet apart in a row depending on the depth to which they are driven and the soil resistance. The amount of separation may be determined by measuring the resistance from the first driven rod to any auxiliary rod located at successively greater distances until a point is reached where the resistance is no longer constant but begins to rise. The distance between the first rod and this point then determines the amount of separation between each of the rods.

Resistance of Ground Path

The resistance of the ground path is made up of the following components:

1. Resistance of ground wire and ground rod.
2. Contact resistance between the ground rod and the soil.
3. The resistance of the soil.

The resistance of the ground wire and the ground rod, for all practical purposes, may be considered negligible.

The contact resistance depends on the composition and the condition of the soil surrounding the ground rod. The condition of the ground rod is immaterial as long as it is not coated with non-conducting substances such as paint, asphalt or grease. A rusty ground rod may be just as good as a clean bright one provided the soil is moist, the iron oxide on the ground rod being conductive when it is wet. In moist soil contact resistance is generally negligible.

Soil resistance has the most important influence on the ground conductivity. It is affected by the following factors, viz., composition of the soil, mineral content, percentage of moisture present, and the temperature of the soil.

Soil is composed of loam, clay, sand, or gravel, or any combination of these elements. Clay and loam have the lowest resistance. Next lowest is clay or loam mixed with sand or gravel, then comes sand alone. Gravel has the highest resistance and makes the poorest ground.

The mineral content of the soil af-

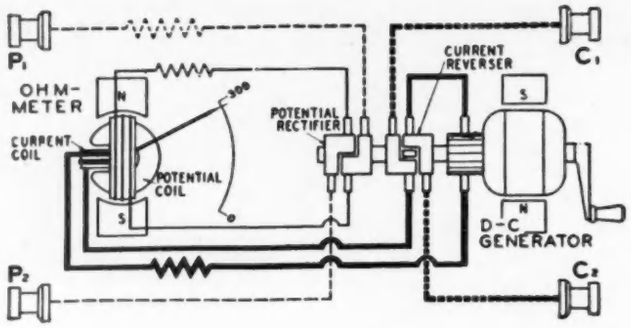


Fig. 5—Arrangement and connections of the elements of the megger ground tester.

fects the soil resistance to a considerable degree. Where soil in a certain locality is deficient in minerals, the addition of salt to the soil will greatly improve the conductivity of the ground, provided the soil is sufficiently moist.

The moisture content of the soil is probably the most important factor in securing low ground resistance. It has been found that if the soil, on the average, contains less than 30 percent moisture, a high resistance ground is likely to result. This has been strikingly demonstrated in times of drouth when the transmission efficiency of ground return telephone lines is greatly reduced and ringing becomes erratic and often fails.

Soil resistance varies with the temperature of the soil being comparatively low in the summer time and comparatively high in the winter time. If a ground rod does not extend below the frost line, trouble will be experienced with the ground going high in resistance during freezing weather. It is advisable therefore, to make sure the ground rod extends several feet below the frost level generally encountered in the particular locality.

Chemical Treatment of Soil to Reduce Ground Resistance

Where the soil is found to be dry part or most of the time so that a high resistance ground would result, chemical treatment can be resorted to in order to make the soil more conductive.

Experience shows that the best chemicals to use for this purpose is common salt. A successful method of applying the salt to the soil is as follows:

About 18" away from the ground rod dig a circular trench 12" wide and 12" deep around the rod. Dissolve 5 or 10 pounds of salt in 3 to 5 gallons of water and pour the solution into the trench. As the solution sinks into the soil add more water until the soil will not take any more water. This treatment is effective for one year or more. In some cases the soil resistance has remained lowered from 3 to 6 years by this treatment.

Concentric Shell Theory

In analyzing the effect of the soil characteristics on the ground resistance it has been found that most of this resistance occurs within six to fifteen feet of the ground rod. To account for this phenomenon, the concentric shell theory has been propounded. This theory is as follows:

Referring to Figure 2 which shows a cross-section of the soil surrounding the ground rod, dotted lines represent the boundaries of the concentric shells. Shell No. 1 immediately surorunding the ground rod is high in resistance because the volume of the earth contained therein is small. Shell No. 2 is lower in resistance since it contains a greater volume of earth. As more shells are included, the resistance goes down until it adds very little to the resistance of the first few shells. Careful measurements have shown that, under average conditions of soil density and moisture content, 90 percent of the soil resistance occurs within an earth shell of 6 to 10 feet radius around the ground rod.

Measurements of Ground Resistance

Although the measurement of ground resistance is not of great importance in the case of substation grounds that have been properly installed in soil of good low resistance characteristics, there are certain occasions when it is necessary to know what the resistance of a ground connection is. Such occasions arise when great variations in soil resistance are encountered within an area where it is desired that a good ground be obtained. In a location of this kind, the soil may be dry and porous. If the ground is an important one, such as one to which a central office battery and protective apparatus are connected, it is highly desirable that the resistance of the ground be measured.

Measurement of the ground resistance cannot be made merely by connecting an ohmmeter or wheatstone bridge between two grounds, since the effect is to obtain the resistance of the two grounds in series and it is impossible to tell which one has the higher resistance and by how much. A method that overcomes this difficulty is to measure the resistance between the regular ground and each of two auxiliary grounds installed equidistant from each other and sufficiently spaced apart so that the concentric earth shells of each ground rod will not overlay each other. The ground resistance then can be calculated by the following formula:

$$R_G = \frac{R_1 + R_2 - R_3}{2}$$

in which: R_G = Ground resistance.
R_1 = resistance measured between regular ground and one auxiliary gnd.
R_2 = resistance measured between regular ground and other auxiliary gnd.
R_3 = resistance measured between the auxiliary grounds.

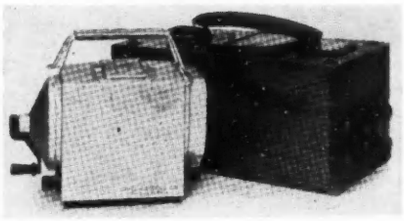


Fig. 6—"Meg" (on left) and "Megger" ground testers produced by the James G. Biddle Co.

A wheatstone bridge with a 1000 cycle oscillator and headphones is utilized for measuring the resistance. The bridge is balanced when no tone or the minimum tone is heard in the receiver. An ohmmeter may be used for the same purpose, as well as a d-c wheatstone bridge, but care should be taken that ground potentials do not cause erroneous readings.

Another method of measuring the ground resistance makes use of the **a-c fall of potential** principle. As illustrated in Figure 3, an auxiliary ground rod is driven into the earth some distance away from the regular ground and an a-c ammeter is inserted in series with the two grounds and a source of alternating current to measure the current flowing in the earth. At a certain point between the regular ground and the first auxiliary ground, another auxiliary ground is installed, and a voltmeter is connected between the second auxiliary ground and the regular ground to measure the voltage drop resulting from the current flowing in the earth resistance. By Ohm's simple law (voltage divided by current), the ground resistance is calculated. This method is subject to

considerable error unless the meters are of the high resistance type, and it is inconvenient when an a-c source is not readily available for this test.

The foregoing described principle is utilized in the Megger method of measuring ground resistance with several differences as follows: Referring to Figure 4, a d-c generator is used in place of the a-c source mentioned and the current output is reversed by a commutator. At the same time, another commutator rectifies the current flowing through the potential coil from the ground connections. Since the output current flows through a coil mounted at right angles to the potential coil and these coils are poled to produce opposing torques, the meter needle will deflect to a certain position on the scale according to the ratio between the voltage across the potential coil and the current flowing in the current coil, producing a reading that indicates the resistance of the ground. Figure 5 illustrates the arrangement and connections of the elements of the ground tester and Figure 6 shows the external appearance of the "Meg" and "Megger" ground testers.

The advantages of these two instruments are that they are direct reading and require no calculations to evaluate the ground resistance, and that stray currents have no appreciable effect on the accuracy of the readings.

Practical Applications of Grounding Principles—Station Grounds

When installing a ground at a subscriber's station, one of two grounding methods may be employed. Connection may be made to a cold water pipe or to a ground rod. In general, the water pipe connection is utilized in an inside protector installation, while a ground rod is used with an outside protector, the last being necessary to avoid running the wire into the building to reach the water pipe. If no water pipe or other permanent ground is available on the subscriber's premises, a driven ground must be used. In some cases it is possible to install the rod in the basement if the latter has a dirt floor, but it is better to use an outside protector and make the ground connection outside the building. Connection to a gas pipe, sprinkler system, or electrical conduit should be avoided.

Figure 7 shows how a ground connection is made to a cold water pipe. Before attaching the ground clamp, the pipe should be thoroughly cleaned with an emery cloth strip to remove dirt and tarnish. Paint or rust should be scraped off with a fishback file or other suitable tool before using the emery cloth.

To install a ground rod for an outside protector, select a place where the soil is moist and dig a shallow trench as shown in Figure 8. Pour a small amount of water in the trench at the point where the rod is to enter the ground. (To avoid the loose soil and rubbish commonly found close to the foundation wall, drive the ground rod at least 12 inches away from the wall.) Push the point of the rod slowly and steadily into the soil until it will go no farther. Then rotate the rod slightly to allow the water to run into the hole and continue pushing. Pour more water into the hole as the pushing and rotating operation is continued until the rod is three inches below the surface of the soil. After splicing the tail of the ground rod to the ground wire replace the dirt in the trench and tamp it down firmly.

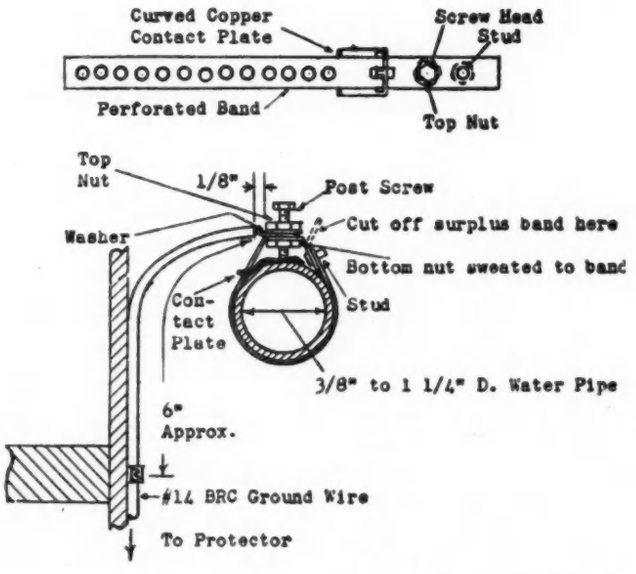
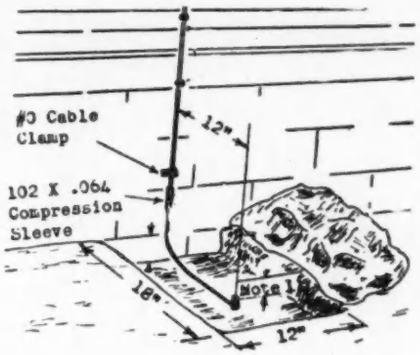


Fig. 7 — Use of ground clamp to connect ground wire to water pipe.



Note: Ground rod should be three inches or more below top of trench.

Fig. 8—Method of installing subscribers station ground.

If the soil is frozen, a frost bar should be used to make the trench. A hole then may be punched through the remaining frozen layer of soil to reach the subsoil, using a heavy rod or hammer. The ground rod may then be pushed into the soil in the same way as previously described.

The ground rod should not be bent at an angle or left with the top protruding through the surface of the ground. If hard pan is encountered below the surface and the rod cannot be driven farther into the soil, the rod may be driven at an angle, preferably away from the foundation wall.

Central Office Ground

The installation of a central office ground requires more care than in the case of station grounds. The central office ground is connected to the positive side of the battery and usually discharges direct current into the soil resulting in electrolysis problems. The presence of salts and acids in the vicinity of the office ground will cause serious corrosion which otherwise might have been negligible were it not for the direct current discharge.

The most effective and economical type of central office ground is one made of heavy copperweld rods at least 10 feet long and connected in multiple by means of a heavy copper cable. Two or more rods should be driven six to ten feet apart in a straight line until the top of the rods are six inches below the surface. The cable used to connect the rods together is laid in a shallow trench and soldered to heavy copper tails on the rods.

The number of rods to be installed depends on the resistance of the ground to be obtained. The resistance of an office ground should never be higher than five ohms as determined by means of the testing equipment previously described.

USITA EXECUTIVES CONFERENCE

on Postwar Problems - - April 16 - 17

By CLYDE S. BAILEY
Executive Vice President

WITH the exception of 1945 a Spring Conference of the executives of Independent telephone companies has been held under the auspices of the United States Independent Telephone Association for many years. We are happy that the war restrictions which prevented a Conference last year have disappeared, and that telephone executives can gather again to discuss problems confronting management.

Our 1946 Executives Conference at the Edgewater Beach Hotel on April 16-17 will be an unusually important one because it will be the first time since our enemies were vanquished that managements of Independent telephone companies have been together at a national meeting to discuss the significant issues confronting us in the postwar period.

The meeting will not be a convention. It will be, what its name suggests, a conference of the executives of Independent telephone companies. At our national convention next October we shall be glad to have all branches of the telephone business represented, from the president on down to the office boy. But the Executives Conference in April is one for management. It is a meeting of and for the policy makers.

A carefully budgeted schedule has been prepared for the two-day meeting under which a limited number of subjects will be considered. Each subject will be assigned a certain amount of time which will be indicated on the printed program and speakers will be advised in advance how much time they will be expected to take. Our president, Colonel William C. Henry, as the presiding officer will see to it that the program as arranged is carefully carried out.

Clyde S. Bailey

We feel fortunate that we have been able to persuade those who will address the Conference to give us the benefit of their time and knowledge in discussing the postwar subjects that are pressing upon us for attention.

Raymond Moley has indicated his willingness to address us upon the general economic problems facing the nation as a whole. The title of this distinguished citizen's address will be "The Frozen Frontiers of Business." Mr. Moley is well known as a journalist, author, speaker, Professor of Public Law at Columbia University, an Associate of *Newsweek*, as well as a former Assistant Secretary of State. What he has to say will be at once challenging and illuminating and will assist us in beginning our Conference with a broad perspective.

Other speakers to appear on the program are recognized leaders in the Independent telephone industry best qualified to handle the particular subject assigned to them.

Perhaps we may not all find ourselves in agreement on what constitutes the major issues of the day, but certainly all must admit that the threat to the Independent telephone industry inherent in pending minimum wage legislation presents a challenge to the best minds we have. This threat will continue to a very substantial degree even if we should prove successful in persuading Congress that our present 500-station exchange exemption should be increased to include all exchanges with less than 1,000 stations.

This matter is going to be aired at the Executives Conference by people who have been on the firing line in the legislative battle and by practical operating people whose job it will be to find ways to meet the increased operating costs if Congress passes a new minimum wage bill. There is to be a panel discussion of this topic at the Executives Conference, coupled with a discussion of other employment relations problems of primary concern to company management.

Another topic the telephone executives will certainly wish to discuss is telephone service. The kind of service the public was willing to put up with when battles were raging and first call on critical materials had to be given to munitions

Wm. C. Henry

plants, is not the kind the public demands today. Recent service investigations started by several regulatory commissions reflect this demand. Every telephone company wants to improve its service as fast as possible. At the Executives Conference there will be a lot of comparing of notes on measures that can be taken to elevate service standards.

Everybody these days is talking about radio as a means of supplementing wire telephone facilities. At the request of the telephone industry the Federal Communications Commission last year allocated certain channels for highway mobile radio telephone service and other forms of telephone service in which radio can play a part. The Plant and Commercial Committees of the National Association have just completed a broad study into the ramifications in the new technology. More and more telephone companies are looking into the possibilities of using radio in their telephone operations. This topic is another one to be explored in its broader outlines at our Executives Conference. The discussion is to be nontechnical and designed to acquaint telephone managements with the Whys and Wherefores. It will be led by a panel of three men chosen for their outstanding qualifications in this new field.

A solution to the rural telephone problem is something all of us have been seeking. Search for a solution has been going on at a more rapid rate as a result of various legislative proposals in recent times. Now that the war is over we may expect the search to proceed at an even faster pace. The progress being made in getting a phone to the farmer will receive its share of attention at the Executives Conference.

Important get-togethers have been held during the past year by our very capable Toll Compensation and Settlements Committee with representatives of the American Telephone & Telegraph Company concerning our toll relationships with the Bell System companies. Our Committee will have something of much interest on this subject to talk about.

The present tax situation as related to the telephone industry is something upon which tax conscious telephone executives want as much light as possible. They are going to get it at the April 16-17 Executives Conference.

More than a year ago the National Association was foresighted enough to recognize that various commercial, plant and inter-company problems would arise early in the postwar period when conversions from manual to dial operation were permitted under relaxed priority restrictions. It was recognized that vexatious questions would be presented when control office contracts come to be written. The Dial Interexchange Committee then appointed has been making intensive studies of these problems and has had conferences upon them with representatives of the American Telephone & Telegraph Company. This Committee is going to have an important report to make at our Executives Conference.

An advertising program for the coming year is a subject that will be reported upon by our energetic Advertising Committee.

Developments in connection with the continuing property record requirements of existing accounting systems will be discussed by our Continuing Property Record Committee, which will report upon the results of conferences with representatives of the regulatory bodies including the Federal Communication Comission. Because of various considerations the FCC has granted extensions from year to year of the date for setting up accounts on an original cost basis and completing a continuing property record plan. The last extension runs only until June 30, 1946. What then?

Other current accounting problems, of immediate interest to company managements, will be dealt with by our Accounting Committee. What about the impact of the recent decision of the U.S. Supreme Court in the New York telephone accounting case? What are the regulatory commissions likely to do if your plant accounts have not been set up in accordance with original cost as that term is currently being defined? Our Accounting Committee is prepared to discuss these questions at the Executives Conference.

Everybody of course will be especially interested in what is going to be said by the chief executive of the Association,

Raymond Moley

President William C. Henry, whose address will open the Conference. Although the title of his remarks is set down as "A Peep Over the Horizon," anyone who has ever seen in action the man at the Association's 1946 helm knows that a pretty full view of the problems that are over the horizon will be given by him if it is possible for anyone to know what is beyond. And of course, our chief executive will have pertinent comments to offer concerning the responsibilities and obligations of our industry in the period that lies ahead.

At a show I attended some years ago a stage character desiring to pay a titled personage a compliment, said "By jove, Duke, you are a prince!" From World War 1, William C. Henry emerged as a captain, and he has been familiarly called "Cap" ever since. President Henry has had a wealth of experience with the Signal Corps and with General Eisenhower in Europe, and from World War II he came out a full colonel. But, by jove, the Colonel is still "Cap" to his friends in the industry, and he likes it that way.

The Washington legislative situation will be discussed at the Conference by your executive vice-president, who will also tell you telephone executives something about various other Association activities upon which he thinks you should be brought down to date. The Association's secretary, too, will have a message that will be interesting.

A word of caution should be given. The attendance at the Executives Conference is going to be large, larger perhaps than ever before. Rooms will be scarce. For this reason we emphasize that the Conference is one

(Please turn to page 68)

Conducted by tne
Observer and his Gang

THE Observation Tower

If you have observations or even a friendly bit of argument suitable for use in this column, you are invited to send them along, which automatically makes you a member of the Gang. You will be anonymous—no names of telephone people or telephone companies are used in this column. Address "The Observer," in care of TELEPHONE ENGINEER AND MANAGEMENT.

How's Your Nomenclature?

Gang Member No. 220, who is a precise sort of guy (prissy, the women would probably call him), thinks that business, including the telephone business, would be expedited and clarified a lot if people were more particular about nomenclature.

In case you don't know exactly what nomenclature is—and you probably don't—we'll tell you. We know. The reason we know is that we looked it up in the dictionary.

Nomenclature, says N. Webster, is the words or terms used in an art of science. In the telephone business, therefore, it is the words or terms used to mean things pertaining to the art of science of telephony.

Most people, says Gangster No. 220, are notoriously careless about the words they use in conversation about anything. The consequence often is, he asserts, that when a person thinks he is conveying a very definite meaning to another person, the other person may receive quite a different meaning.

That, he says, is bad, but it is not serious in ordinary conversation; most people express their meaning clearly enough to make themselves understood pretty well, even if the hearer has to do a little guessing about it. For instance, he says, if a fellow asks a gal to marry him she'll get the meaning all right, even if some of the words he uses mean nothing more to her than if they were Hindustan.

But, says this Gang Member, people should not be careless in talk about business, art or science—all of which he presumably considers a lot more important than asking a gal to marry you.

What we need, he thinks, is to have a precise and definite meaning, understood by all, for every technical word used in the industry. Take, for example, the word "depreciation."

Sometimes this word is used to mean the actual deterioration of something. Sometimes it is used to mean the amount that is accrued from income to overcome deterioration of plant. Sometimes it is used to mean the amount a company has on its books as a reserve against deterioration. And so on.

Now, if we were all precise and careful about our nomenclature, the word "depreciation" would mean just one specific thing and that only, and everybody would use it to mean that and that alone.

There are other words, much used in the industry, that frequently mean one thing to the user and another to the hearer. Take, for instance, the word "technique." Just what does "technique" mean—to you?

There is also a class of words that are frequently overworked. The word "standardization," for instance. We hear a lot about it in the telephone business, but it often means different things to different people. One man may be thinking of standardization of equipment; another of standardization of methods, or of something else entirely.

Maybe we should have a Committee on Nomenclature, which would define the usage of these all-embracing words, so that we would all know just what they are intended to mean in the telephone business, and we would all use them to mean just that.

There are nomenclature dictionaries in some industries, designed for just that purpose. Gang Member No. 220 thinks that if we had such a dictionary in the Independent telephone business it would greatly clarify our thinking and speech, and expedite the conduct of the business.

In the Matter of Standardization

Speaking of standardization, as we were a few paragraphs ago—

We make so bold as to disagree with some of our telephone friends who see, in the standardization of almost everything connected with the industry, a cure for many ills of the Independent telephone business.

We think that, on the contrary, one of the principal assets of the Independent telephone industry is its flexibility; a flexibility that allows the owners of an Independent telephone exchange to construct, equip, maintain and operate it in the manner that is best for the territory in which it operates.

Of this we are sure: If all the Independent telephone plants in this country had had to be built, when they were built, in accordance with some standardized plan and procedure, there would not be half as many Independent telephone exchanges in this country as there are now. Perhaps not one-fourth as many. Perhaps none at all.

The Independent telephone industry exists today because telephone exchanges could be built and put into service in

the manner that at the time best fitted the pocketbook of the builders and the service necessities of the community. In the early days of Independent telephony, standardization would have been a blight—not an advantage.

It can, of course, be argued that the pioneering days have passed, and that the Independent industry should now settle itself down to a standardization of plants, equipment, methods, services—and perhaps even rates.

Our answer to that is the question: Why?

Independent telephone exchanges in the U. S. do not comprise a nation-wide system under one ownership which needs—partly for the purpose of making administration of it easier—to be built or operated under a uniform system of doing things. Uniformity, or standardization, is not by itself a virtue; it becomes an advantage only when it accomplishes something of value. And it should not be overlooked that standardization of things or methods sometimes costs more money than non-standardization.

In toll work—which is, of course, a nation-wide service—there must be a degree of standardization throughout the entire telephone industry, and there is.

But as to local work—construction, for instance—if the Oompah Telephone Company in Texas finds it more economical, because of the terrain and climatic conditions, or for other reasons, to guy its poles a certain way, and another company in Maine has found it best for that part of the country to guy them another way, then why should both companies guy their poles the same way?

Conditions differ vastly throughout this broad land. You can build and live comfortably in an adobe house in Arizona—it would not last as long as the proverbial "June frost" in Vermont. Why should telephone construction be the same in both states? Why should operating methods be the same in both places if—as frequently happens—methods more suitable to local conditions are better for the community and often more economical too.

Maybe we're wrong about our nomenclature on this proposition of standardization. But we think that standardization can be carried much too far in the Independent telephone field. Just because it seems to be a good thing for a nation-wide system does not mean that it is likewise a good thing for some 12,000 separate Independent telephone exchanges operating under a great variety of ownerships and managements and also under as great a variety of conditions of climate, terrain, characteristics of the local population and other things.

To do a thing a certain way because that is the best way to do that thing at that place and that time, is good sense. To do it a certain way because somebody else does it that way, may not be so good. Standardization may be not only an asset, but also a necessity, for the very large business; for the small business we think that individuality still counts a lot.

"Everybody's Doing It."

Gangster No. 226 is a student of what he says is called "Mass Behavior." This, as we understand it, is the art of figuring out in advance what a large number of people will do under given circumstances. Such knowledge is valuable in many kinds of businesses. Chain stores, for instance, use it in determining the best locations for new stores. They count the number of people who pass, during certain hours, the location under consideration. They know, from experience elsewhere, about what percentage of passers-by will come in for the purpose of buying something.

Gang Member No. 226 has been using his knowledge of mass behavior to make some calculations on the future growth of telephone stations in this country. He thinks that if the telephone companies themselves display aggressiveness for the purpose of increasing stations, the growth will be tremendous during the next several years.

Wartime use of the telephone, he says, has created the "telephone habit" throughout the country. Millions of people who made little use of the telephone before the war have now become accustomed to it as a routine part of their everyday life. This situation, says this Gangster, exists in even the smallest communities.

If telephone companies want to grow, he asserts, now is the time to do it, by catching and making use of the impetus given the use of the telephone during the war. But if telephone companies do not do that, he thinks, then in a few years that impetus will fade away again.

We think this is good sense. Of course the problem right now in many exchanges is to catch up with held orders still on hand. But that should not take long after equipment, instruments, materials and labor are again available. The big question as to the growth of stations is that of what telephone companies do, or do not do, after present held orders have been taken care of.

It is, we believe, defeatist thinking to believe that we have reached, or ever did reach, anything like saturation of telephone stations in this country. Stations will probably increase by 50% or more, in the next ten years, whether the companies do anything about it or not— other of course, than to furnish the facilities. If the companies do act aggressively to obtain growth in stations, they will probably increase 100% in that time.

The long-range problem will be to bring about the growth as evenly as possible throughout the country. That is, to have growth in the smaller cities and towns as well as in the great metropolitan centers. That is the part of the problem that should interest the Independent telephone industry greatly.

Our own feeling is that, ten years from now, there will probably be more than 50 million telephones in the U.S.A. We think there will certainly be that many if the telephone companies themselves go after growth aggressively.

Add To Your Technical Notebook

A Gangster has just told us of the manager of a mutual telephone system who went to a convention, heard a talk on transpositions, and went home and transposed a grounded, bracket line. He put the bracket on one side of one pole and on the other side of the next pole, and says the line works much better.

Annual Sale of Easter Seals will be held March 21-April 21. The National Society for Crippled Children and Adults, 11 S. LaSalle Street, Chicago, Illinois, assists disabled children and adults through our voluntary contributions.

GOOD LIGHT

...for Good Sight

ADEQUATE illumination is necessary in both home and business to insure against eye strain. It is of particular importance to telephone companies in both operating and terminal rooms. The provision of proper lighting on switchboards presents somewhat of a problem. The illumination level must be sufficiently high that operators can readily determine numbers and yet not so high as to make it difficult to recognize the lamp signals.

Measurement of Light

The development of voltaic type photocells has made possible the simple and accurate measurement of light intensity. A direct reading illumination meter makes it an easy matter for anyone to determine the adequacy of a lighting installation. It is, of course, also necessary to take into account glare and reflection effects which might adversely affect a lighting installation.

The intensity of a light source is generally defined in terms of its *candle power*. The illumination value of one candle power is based on the light produced by a standard candle burning under certain specified conditions. The term *candle power* expresses only the light intensity and not the total amount of light which may be emitted by a light source.

The total quantity of light given out by a light source is expressed in terms of the *lumen*. The total lumens emitted by a standard candle is approximately 12.57. This relationship between lumens and candle power results from the fact that if a standard candle is placed in the center of a sphere having a radius of one foot, the amount of light that would fall on any square foot of surface of the sphere is taken as one lumen inasmuch as there are 12.57 square feet in the total surface area of a sphere. The total lumens emitted by one standard candle would therefore be 12.57.

Table No. 1—Typical Lighting Intensities for Various Conditions

Lighting Condition	Foot Candles
Full moon	0.03
Well lighted street	1.0 - 2.0
Inside of average lighted building	5.0 - 50.0
Daylight—in shade	100 to 1000
Daylight—in sunlight	5000 to 10,000

Practical Measurement of Light

In conducting a lighting survey of an existing installation, we are concerned primarily with the light intensity at a given point in a room, for example, the light intensity on the top of a desk. A unit known as the *foot candle* is employed in defining the degree of illumination at the point of utilization. A foot candle represents the illumination at a point on any surface which is one foot distant from and perpendicular to the rays of a one candle power light source.

Fig. 1 illustrates the basic difference between the foot candle, the lumen and candle power. Illumination meters are calibrated in foot candles. The accompanying table gives typical foot candle values for various lighting conditions.

In designing new lighting installations we often need to know the number of lumens of light which are to be provided on the working plane. This can be determined by multiplying the intensity of light desired (foot candles) by the area (sq. ft.) to be illuminated, i.e.,

Ft. candles x area in sq ft. = lumens.

Efficiency of Incandescent Lamps

The efficiency of an incandescent lamp is expressed in *lumens per watt* and varies with the lamp wattage. It increases as the wattage of a lamp is increased. Table No. 2 gives the initial lumens, efficiency and average life of typical incandescent type bulbs. It will be seen that the efficiency (in lumens per watt)

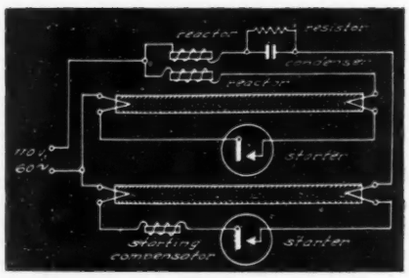


Fig. 2—Circuit of typical fluorescent lamp.

varies from approximately 8 for a ten watt bulb to as much as 19½ for the 300 watt size. From this it can be seen that a high wattage lamp would be more economical from a power consumption standpoint than would a number of smaller lamps of equivalent wattage. However, in many situations the smaller lights may be the best answer to a specific problem because of the question of light distribution which can in most

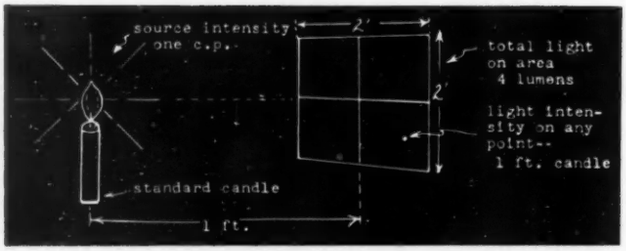


Fig. 1—Basic illustration of difference between foot candle, lumen and candle power.

cases be better arranged with several light sources rather than a single high wattage source.

Life Characteristics

Typical incandescent lights can be expected to give approximately 1000 hours average life. The life of a filament type lamp is influenced by the condition of use and line voltage. If a lamp is subjected to vibration or frequent jars, its life will be greatly shortened.

Lamps are designed so that the cost of the light obtained is in economic balance with the power cost and lamp cost. If lamps are operated at voltages in excess of their rated value, they will produce substantially more light but will have a much shorter life.

Effect of Voltage on Lamp Performance

Table No. 3 shows the effect of voltage upon lamp performance. It can be seen that operating a lamp at ten percent above rated voltage increases the power consumption 16 percent and the light 37 percent but the lamp cost increases 228 percent. From what has just been said, it is apparent that a telephone company should give some thought to line voltages.

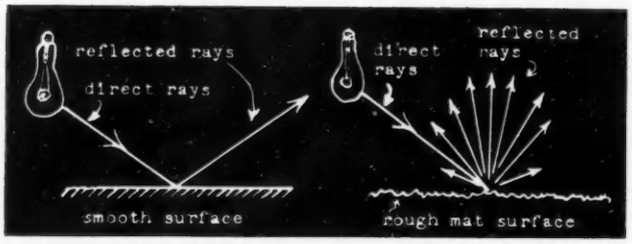


Fig. 3—Effect of different types of surfaces on reflected light.

If the line voltages are higher or lower than normal (115-120 volts considered as normal) the power company should be consulted and asked to adjust load taps to produce proper voltages. Care should be taken to purchase lamps of the proper voltage. Incandescent lamps are generally available in ratings of 105, 110, 115 and 120 volts. Low voltage at the lamps may be due to over-loaded wiring. This point can be checked by measuring the voltage both at the meter and at lamp fixtures.

Types of Lamps

Illumination may be obtained electrically either through the medium of *incandescence* or *luminescence*. The major part of present day home lighting utilizes the incandescent type of lamp. Business houses have in recent years leaned heavily toward the luminescent type of lamp, best exemplified by fluorescent lamps. Fluorescent lights are characterized by their direct transformation of electrical energy into light without first converting the energy into heat. Fluorescent lamps produce light as a result of the ultra-violet rays generated within the lamp bombarding certain *phosphors* which fluoresce.

The ultra-violet rays are produced by a small amount of argon gas and mercury within the tube. In most fluorescent lamps heated filaments are used for a short interval when the lamp is first turned on, and these are then automatically disconnected. The filaments help to produce ionization of the argon gas and thus start the flourescent action in the tube.

Mechanism of Fluorescent Lamps

Most fluorescent lamps are equipped with a *starter* and a *ballast coil*.

The purpose of the starter is to automatically disconnect the filament circuit after it has been connected to the line for a few seconds. The ballast coil serves the dual purpose of producing an initial high voltage surge at the instant the starter contacts open and also it acts to reduce the working voltage on the tube from 110 to approximately 60 volts.

The starter consists of a small evacuated metal or glass cylinder containing a bi-metallic strip, a set of operating contacts and an inert gas such as neon. When the lamp switch is first turned on, the voltage appearing across the starter switch (contacts open) causes the starter to glow. The resulting heat causes the bi-metallic strip to operate and to close the filament circuit through the ballast coil. Closing of the contacts extinguishes the glow discharge in the starter. The bi-metallic contact then cools and opens the contacts. Interruption of the current flowing through the ballast coil causes an "inductive kick" or rise in voltage which appears across the filament electrodes and initiates the glow discharge within the fluorescent tube. The voltage drop (IZ) in the ballast coil reduces the voltage across the electrodes to approximately 60 volts which is insufficient to ionize the neon gas in the starter. The starter

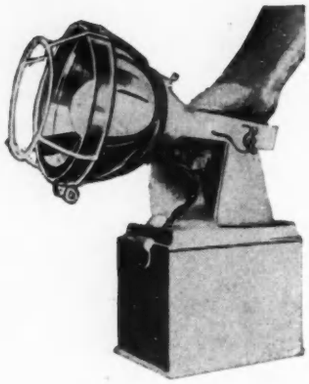
Table No. 2—Initial Lumens, Efficiency and Life Characteristics of Tungsten Filament Lamps.

Watts	Initial Lumens	Rated Initial Lumens per watt	Rated Average Life
6	40	6.6	1500
10	78	7.8	1500
15	147	9.8	750
25	270	10.9	750
40	472	11.8	1000
50	670	13.4	1000
60	834	13.9	1000
75	1,110	14.8	750
100	1,640	16.4	750
150	2,610	17.4	750
200	3,680	18.4	750
300	5,880	19.6	750

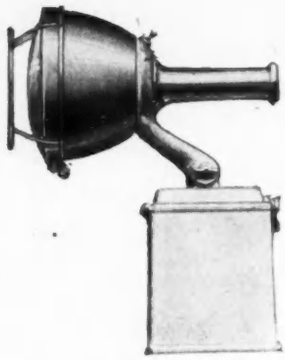
Table No. 3—Effect of Voltage on Lamp Efficiency

Line Voltage in % of Rated Lamp Voltage	Watts Consumed in % of Rated Watts	Lumens of Light in % of Normal	Lamp Cost per 1000 Hours in % of Normal
90%	85%	70%	24%
92	88	75.5	33
94	91	81	44
95	92.5	84	50
96	94	87	59
98	97	93	77
100	100	100	100
102	103	107	130
104	106.5	114	162
105	108	118	185
106	109.5	122	208
108	113	129	266
110	116	137	328

Super 6 Master-Light



Work and Emergency Type WS



Non-spillable Rechargeable Type Super 4

Fig. 4—Several of the portable trouble lights made by the Carpenter Mfg. Co., Cambridge, Mass. Postcard request to the Carpenter company will give you more detailed information on any of their lights.

plays no further part as long as the lamp is operating.

The efficiency of the fluorescent type light is very high ranging from 35 to 45 lumens per watt as compared to 15 to 18 watts for comparable size incandescent lamps. Fig. 2 shows the circuit of a typical fluorescent lamp.

Factors Affecting Good Illumination

Good illumination requires a proper coordination of the light intensity and its distribution. Inadequate light intensity on the working plane causes eye strain due to the lack of contrast displayed by the illuminated objects. Worker operations are slowed down materially by inadequate light intensity. Too little light is far worse than too much. The need for proper light control is best illustrated by the fact that the head lights of a car, if properly designed and adjusted, will give excellent road illumination yet the rays will be so directed as not to blind the oncoming driver. Here ample light properly controlled produces the desired illumination result.

Glare and Reflection

If light fixtures are improperly designed or hung, *glare* and *reflection* effects may make the lighting installation very unsatisfactory even though the illumination level may be high. Glare results largely from concentrated light sources which are located in the field of view and which by contrast with surrounding space cause the light source to appear dazzling or blinding.

Glare may be represented in different degrees. A good example of extreme glare would be the use of a large wattage clear type incandescent lamp without a diffusing fixture. Glare may be due to reflected light from a highly polished surface. Such surfaces pick up and concentrate light rays from a source to the viewer's eyes.

Reflected light is light which has changed its direction of transmission due to impinging on some reflecting surface. Light colored surfaces reflect light more than darker ones. If the surface is bright and highly polished, it will reflect nearly all the light reaching it and the reflected light will have a tendency to be concentrated. If the surface has a dull finish and particularly if it is of the rough matt type (see Figure 3), the light rays will be reflected at many different angles resulting in a dispersal of the light. In order to control glare and reflection effects, a good lighting installation requires that wall and ceiling surfaces be used which do not have a high gloss and which are not too white in color. Light tinted walls and ceilings are, of course, desirable in order to get maximum light from the illumination source.

Indirect Type Fixtures

Fixtures of the *indirect type* are simply inverted reflectors of opaque material. They depend on the ceiling and upper sidewalls of a room to reflect light down into the room. This type of reflector produces minimum glare. However, except for certain applications in which a soft subdued light is desirable, the use of indirect fixtures is not an efficient arrangement. Combination fixtures which reflect 50% or more of the light upward and the balance down into the room are known as *semi-indirect fixtures* and are widely used. In using indirect or semi-indirect lighting fixtures, care must be taken to avoid low light levels due to the use of either lamps which are too small or an inadequate number of fixtures for the floor space coverage.

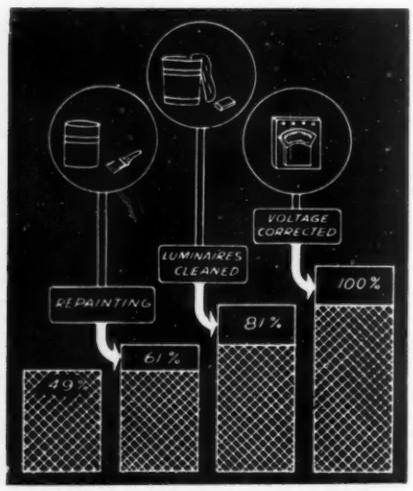


Fig. 5—Various steps required to bring a run-down lighting installation up to full efficiency.

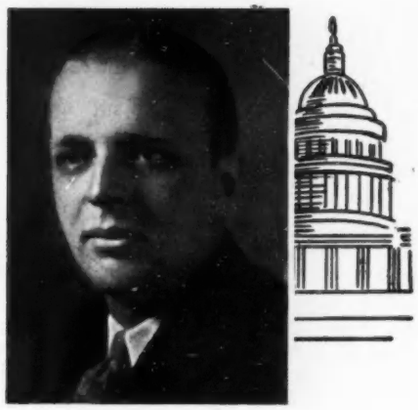
Flash Lights

Adequate light when and where it is needed is more important than is generally recognized. A telephone installer working in a dark basement can take two hours to do a one hour job if adequate light is not available. Most of the larger companies consider a flash light a standard item in every installer's kit. Because of the rough use that flash lights receive it is essential that flash lights designed especially for industrial purposes be used if long life and reliable service is to be obtained. Their initial cost is somewhat higher than the hardware store variety of flash light but they will outlast several ordinary flash lights and can be relied upon. These lights are available with a shatter proof lens which is desirable because of the rough handling they receive when carried in telephone trucks and installation kits.

Companies operating a substantial number of stations will be interested in the storage battery type flash light cells which are now available. These consist of a single lead acid cell in a plastic container and so designed that the sulphuric acid electrolyte cannot spill out regardless of the position in which the cells are used. These cells must be used with

(Please turn to page 64)

Roland C. Davies
Editor
Telecommunications Reports



Our WASHINGTON *BUREAU Reports*

By
ROLAND C. DAVIES
and FRED HENCK

THE Labor Department announced early March 7 that a wage settlement had been reached, averting a threatened nationwide telephone strike only 15 minutes before the 6 a.m. deadline for the walkout.

The tip-off of the March 7 strike settlement came at about 11:00 P.M. March 6 when Joseph Beirne, president of the NFTW, who was due to go on the air for the Columbia network, cancelled his talk. Had the strike been consummated, it would not have affected Independent companies except on long distance operations and NFTW affiliates would not have gone out. The strike had been planned as an orderly one, with no mass picketing at building entrances, but settlement came in time to cancel the walkouts.

The Labor Department released an announcement saying that as a result of an agreement reached at 5:30 A.M., March 7, between the Federation of Long Lines Telephone Workers and the American Telephone & Telegraph Co., "a national pattern was established" for averting the threatened stoppage.

Edgar L. Warren, director of the U. S. Conciliation Service, said that the agreement also would result in termination of the strike at the Western Electric plant at Kearney, N. J.

The possibility that Congress may act to prevent suspension of public utility, communications, and transportation services resulting from labor union walkouts appeared early this month as the threats of nationwide telephone and railroad tie-ups were added to the repeated local and regional public service labor difficulties of recent weeks.

The New York tugboat and subway disputes, the Philadelphia transit tie-up, the Pittsburgh power walkout, and the Detroit milk strike have had their effect in increased suggestions that no further suspension of public service should be tolerated.

The influencial Washington D. C. *Post* closely watched by Congress, was one of the latest to adopt this line of thinking. In an editorial inspired by the telephone strike, the *Post* warned that public interest demands orderly settlement of such wage disputes without resort to work stoppages. The editorial noted that announcement of the telephone strike "once more illustrates the helplessness of the United States Government in the face of industrial disputes. A mere handful of organized workers has undertaken to cripple our communications system."

Although Congress—more particularly the Senate—has shown reluctance to restrict the strike powers of organized labor in the past, and especially those of any specific group of workers, the top-heavy House vote favoring the Lea Bill to curb the activities of radio musicians' labor czar James C. Petrillo may be indicative of a changing temper in this respect. It should be noted that, on the Senate side, conferees were named immediately after the passage of the Petrillo measure to iron out difficulties between it and the similar but much weaker Vandenberg bill, approved by the upper chamber more than a year ago.

Another aspect to be considered is the bitter reaction of many Congressmen to any labor tie-up which affects their daily routine. Although the legislators have hesitated to take action on walkouts affecting the entire national economic and reconversion picture, like the General Motors, GE-Westinghouse, and steel strikes, a number of them were moved to vigorous protest when their telephone service was curtailed during the eight-day operators' work stoppage in Washington last November, and when Capitol Transit street cars and buses did not run during the walkout of that company's employees.

Although the establishment of a nationwide wage pattern for Bell System workers was one of the primary blocks to immediate settlement of the telephone wage dispute, there does not appear at present to be any inclination by the NFTW leadership to attempt to extend such a yardstick to Independent operating companies in smaller cities and towns.

The union's reasoning with regard to the Independents is still on an "ability to pay" basis, it was understood, and no extension of Bell wage scales to the smaller Independents is contemplated at present.

At the same time, it appeared that final approval of minimum wage legislation may be deferred for some time. Both majority and minority reports on Senator Pepper's measure were submitted to the Senate. The House Labor Committee, in the meantime, had a total of eight minimum wage measures before it, and may write its own bill combining features of several.

The Senate measure approved by the Educational and Labor Committte was definitely understood to have raised the exemption covering switchboard operators in telephone exchanges up to 1000 stations, rather than the present limitation of 500 contained in the Fair Labor Standards Act. The minority report seeks to broaden some exemptions, including those affecting Western Union, and upheld tht 1000-station limitation,

which had been sanctioned by the Committee majority.

Porter Resigns from FCC

Former FCC Chairman Paul A. Porter formally resigned his appointment to the Commission, shortly after his confirmation as OPA Administrator, putting to rest the rumors that he would be on a sort of leave status from the FCC during his tenure with the price-control agency. But speculation that Mr. Porter will ultimately return to the Commission continued, particularly after President Truman declared at a press conference that he will not fill the FCC vacancy immediately.

It appears rather unlikely, however, that Mr. Porter, one of the Commission's most successful and highly-respected chieftains, will return to that body. His appointment as OPA Administrator placed him on virtual Cabinet level, and his position as a member of the White House inner circle is well-known. Thus a downward return step to the FCC does not, at this time, seem probable for Mr. Porter.

The naming of Commissioner Charles R. Denny, Jr., as acting chairman is a merit appointment of the first order, just as was Mr. Denny's elevation to the Commission from his post as FCC General Counsel. The new acting chairman has indicated that the Porter policies, in general, will be followed. He stipulated that the clearing of the backlog of accumulated standard, FM and television broadcasting applications is the FCC's first priority business in the next month or two.

The Commission's required emphasis on broadcast questions, resulting from the load of new service applications during the war, together with the trimming of $700,000 from the original Commission budget request, may give the telephone industry a respite from the new regulatory measures. Although the Commission is reported to have tentative plans of a large-scale extension of its telephone regulation activities, the $500,000 appropriation cut approved by the House, plus whatever compromise is reached in conference on the additional $200,000 slash made by the Senate, would tend to postpone such a move. This should be welcome news to small Independents who have been measured by the same yardstick as large companies in regulatory actions, at disproportionate inconvenience and expense to themselves.

Surplus Property Sold

The War Assets Corporation has announced that in January it acquired $261,549,000 in communications equipment on a total valuation basis, and of this $4,216,000 was sold. The equipment sold was valued originally at $10,797,000, or two and a half times the total for which it was disposed of. At the same time, sealed bids were being accepted until March 18 on a sale of telephone equipment at the WAC New York regional office at 70 Pine Street. The property, declared surplus by the Signal Corps, included communication wire, and cable switchboards for PBX and central office exchanges, as well as telephone instruments.

WAC Electronics Division Chief W. C. Foss stated that the direct sale method to telephone companies appeared to be the best means of expediting the flow of materials. He declared that the surplus would be a means "to satisfy as soon as possible" the huge backlog of unfilled telephone service orders.

USITA

State commission sources expressed satisfaction with the resolution of the USITA Executive Committee establishing a cooperative system of ordering equipment from telephone manufacturers to alleviate the severe apparatus and supplies shortage which has delayed materially rehabilitation of plant and restoration of service to normal peacetime standards.

The announcement of the Executive Committee was a sincere effort to meet the equipment shortage, it was felt, and in addition may be an important demonstration of an industry's ability to solve such difficulties through voluntary action without Government regulation. It may provide the answer to the questions already posed by the Florida state commission—and expected to come from other state regulatory bodies—concerning the apparent slowness of the operating companies' filling the backlog of accumulated held orders and converting their plants to meet present needs.

Royalty-free License

In the rural telephone field, it does not appear likely that legislation will be passed in the near future, and apparently such action has been all but shelved for the time being. The Bell System's offer of a royalty-free patent license to Independent manufacturers for production of the power line carrier system highlighted recent developments, while plans for the wider use of two-way radio communication to include general service calls were discussed at the National Rural Electric Cooperatives Association convention in Buffalo this month. Mr. Harold S. Osborne, Chief Engineer of the American Telephone and Telegraph Company, was one of the speakers at the convention.

Convention Dates

Tennessee Telephone Association, Andrew Jackson Hotel, Nashville, April 2.

Kentucky Telephone Association, April 4 and 5; no place yet named.

Nebraska Telephone Association, Paxton Hotel, Omaha, April 9-10.

Iowa Telephone Association, Ft. Des Moines Hotel, Des Moines. April 11-12.

National Executive Conference, USITA, Edgewater Beach Hotel, Chicago, Illinois, April 16 and 17.

Ohio Telephone Association, Deshler-Wallick Hotel, Columbus, April 23-24.

Indiana Telephone Association, Severin Hotel, Indianapolis, May 1-2.

Illinois Telephone Association, Pere Marquette Hotel, Peoria, May 8 and 9.

Wisconsin Telephone Association, Park Hotel, Madison, May 14, 15 and 16.

New York Telephone Association, Hotel Onondaga, Syracuse, May 22 and 23.

Pennsylvania Telephone Association, Hotel Lawrence, Erie, June 4-5-6.

Oregon Independent Telephone Association and Washington Independent Telephone Association, Hood River, Ore., June 13, 14 and 15. No hotel named as yet.

Michigan Telephone Association, Hotel Olds, Lansing, September 18 and 19.

USITA National Convention, Stevens Hotel, Chicago, Illinois, October 14, 15, and 16.

North Carolina Telephone Association, Pine Needles Hotel, Southern Pines, November 11 and 12.

Alabama Telephone Association, Jefferson-Davis Hotel, Montgomery, November 18 and 19.

COOK

TYPE

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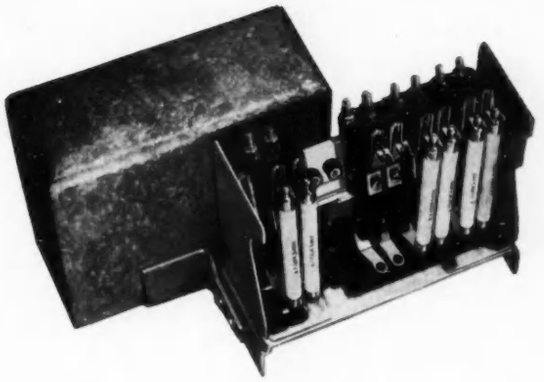

SUB-STATION PROTECTOR

The Type U Utility and Sub-Station Protector Mounting has a variety of uses in the outside plant. It provides protection for small cables and open wires, up to 5 pairs per unit, at railroad crossings and power line crossovers and parallels. It is especially valuable for the protection of subscribers drops where several instruments are closely grouped.

The Type U is a compact, convenient unit furnishing the utmost in versatile utility. It consists of a sturdy, steel hot galvanized base fitted with non-corrosive studs on which as many as five Type H Protector Units may be mounted. A heavy galvanized hood and insulated entrance holes in the base make the entire unit weather and insect-proof. Mounting brackets are so arranged that the base unit may be brought to a horizontal position to facilitate wire connections. When connections are completed the entire unit is raised and secured in its permanent vertical position.

The TRANS-MOUNT SYSTEM

The Type U is a part of the Cook Trans-Mount System of protection and distribution. The Trans-Mount System is composed of the Type U Utility Sub-Station Protector, The Type R Sub-Station Protector, The Type T Main Distributing Frame, the Type S-20 Pole Cable, the Type UA-20 Aerial to Underground Terminal and the Type IT-20 and Type TN-20 Interior Cable Terminal Vaults, all using the Type H Protector Unit.

COOK ELECTRIC Company

Telephone Protection & Distribution Engineering Since 1897

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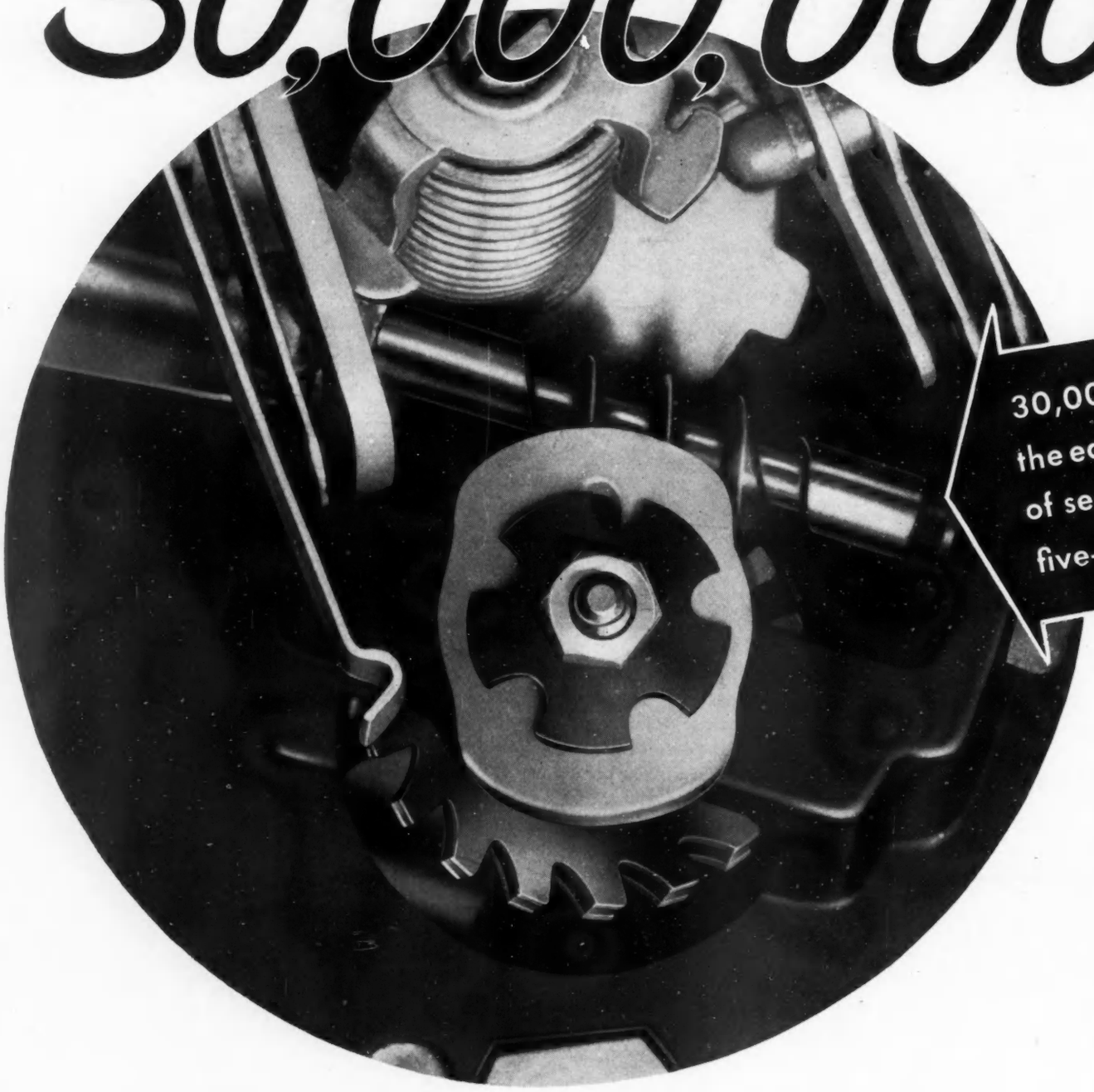

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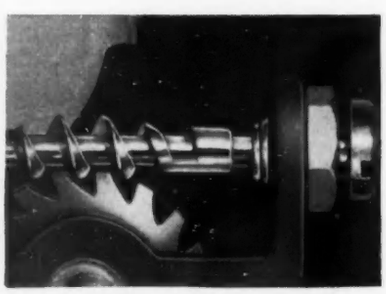
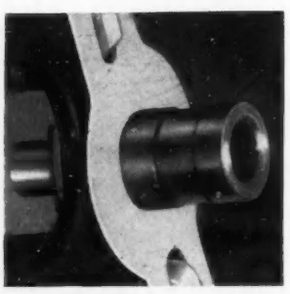


Governor worm is accurately cut — turns smoothly and quietly on ball thrust bearing.

Special laminated worm gear is self-lubricating, non-sticking, long-wearing.



Extra-long main bearing prevents side-play, minimizes wear.

Positive pa lock prevent running a nd of its o

Impulses—

This impulsing mechanism on a standard Automatic Electric dial has already operated more than thirty million times in controlled "life" tests in the Automatic Electric Laboratories. Translate these 30,000,000 impulses into years of service on your own telephones, and you'll know why these rugged dials have been adopted as standard by hundreds of telephone companies.

mpulses is
of 130 years
ne rate of 25
s per day!

You feel the sturdiness of the Automatic Electric Dial in its quiet, silk-smooth operation. Its unique design reduces moving parts to a minimum in number and weight, so there's very little wear on bearings when this dial operates—and no "slamming" blow when it comes to rest. Even the click of pawl and ratchet has been eliminated through the use of a unique "quieted" pawl. These and many other features have been combined by skillful design and manufacture into a dial of matchless dependability and long life.

The quality shown in laboratory tests has been fully proved in actual use. In millions of telephones, over a period of many years, Automatic Electric dials have demonstrated their permanence of adjustment, their freedom from maintenance, and their generally superior performance. Here's a fact to remember when the time comes to select dials for your telephones or switchboard positions.

AUTOMATIC ELECTRIC

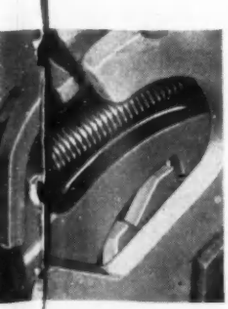
Originators and Developers of the Strowger Step-by-Step "Director" for Register-Sender-Translator Operation . . . Machine Switching Automatic Dial Systems

Makers of Telephone, Signaling and Communication Apparatus . . . Electrical Engineers, Designers and Consultants

Distributors in U. S. and Possessions

AUTOMATIC ELECTRIC SALES CORPORATION, 1033 W. Van Buren St., Chicago 7, U. S. A.

Export Distributors: INTERNATIONAL AUTOMATIC ELECTRIC CORPORATION



ve pa-lock prevents dial over-
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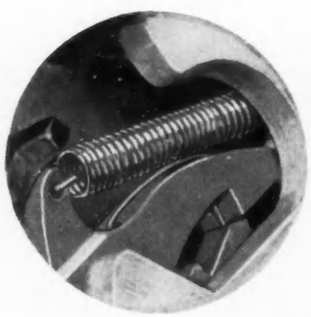
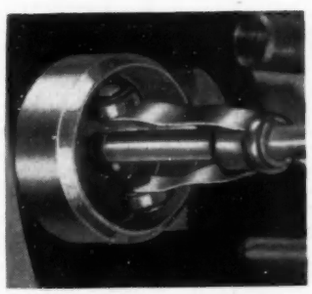
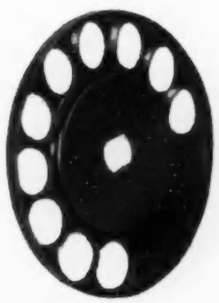


Patented "quieted" pawl makes this the world's quietest commercial dial.



Fibre inserts in governor provide positive speed control, with negligible wear.



Flanged finger-plate provides greater strength, minimizes "fly-wheel" effect.

Personalities

Daniel H. McNulty, mgr. Telephone Repair & Supply Co., Chicago, reports an unexpected development in automatic telephones. The Wisconsin Public Service Commission decided modern, automatic telephones can be antisocial. The Belmont & Pleasant View Telephone Company has persuaded the commission to grant a return from automatic to the old party line system in Fayette, Wisconsin because "It was impossible for parties on the line to listen in as the subscribers were accustomed to do."

•

Edwin S. Staples, Tennessee Valley communications engineer, is now an electrical engineer with the Standard Vacuum Oil Co. and in his new position will be located in the Netherlands East Indies, where he will supervise all telephone radio work of the company.

•

Walter M. Reynolds, information mgr. of A.T.&.T. since May, 1944, is the new publications mgr. of Western Electric, reporting to **F. B. Wright,** director of public relations. **R. I. Johannesen** succeeded Mr. Reynolds as information manager.

•

Sergeant **George Elliott,** star witness in Senate inquiry hearings on radar warning of approaching Jap planes at Pearl Harbor, was a former New Jersey Bell man.

•

Walter Colwell, president of the Independent Pioneers of the Fort Dodge (Iowa) Telephone Company, was in charge of the February and quarterly dinner meeting and election of officers of Fort Dodge Pioneers.

•

Mrs. **Ruby Mae Williams** has sold the Milton and Jay (Fla.) Exchanges to Southern Bell Tel. & Tel. Company.

Frank H. R. Pounsett has been named chief engineer of the Stromberg-Carlson Company Limited of Toronto, Ontario. He was formerly chief engineer of the radio division of Research Enterprises Ltd., which made radar apparatus in Canada for use by the armed forces.

Randolph Eide

Randolph Eide, president of Ohio Bell, reported in his annual report February 21 that while the volume of their business in 1945 exceeded that of any previous year, their net income was so low it was only matched by depression year 1933.

•

Kenneth L. Lawson, directory and methods supervisor of Lincoln (Nebr.) Tel. & Tel., devised a neat telephone number and address booklet that carried a message from the company on the back cover explaining that their supplies of directories were exhausted, which was helpful to their new subscribers. Regular directories were delivered as soon as printed this month.

Dr. **Pearce Davis,** chairman of the national telephone commission until the termination of the WLB in December, became chairman of the department of business and economics at the Illinois Institute of Technology on March 1.

•

Verne Clark, district manager at Middle States Tel. Co., Pekin, Illinois, is also president of the local Sportsmen's Club and sponsors interest in fish and wildlife conservation.

•

Erskine N. White, vice president of New England Tel. & Tel. Company, became general manager of the company on March 11, succeeding **Bartlett T. Miller,** who transferred to AT&T to be assistant to **William H. Harrison,** vice president in charge of operations and engineering.

•

S. R. Hammer, banker, Windom, Minn., has been named receiver for the Hills (Minn.) Telephone Exchange since **L. J. Gordon,** 78, owner of the exchange, failed to improve service and satisfy 136 subscriber complaints to the Minnesota commission last October.

•

Frank Solberg, recently discharged from the Signal Corps, has returned to Central Telephone Company and is managing its Langdon (N. Dak.) system. For nearly three years Mr. Solberg was master sergeant in Alaska in telephone construction work. His unit built the line from Edmonton to Fairbanks and from there to several points within the Artic circle.

•

L. T. Pendleton and **E. L. Florance** have been appointed assistant vice presidents of A.T.&T. under the direction of vice president Leroy A. Wilson.

SMALL SAMPLE OF A BIG JOB!

. . . on the road to record telephone production

After V-J Day, orders were to produce civilian telephone apparatus and cable—*fast!* Western Electric production engineers jumped to it.

At one location, they had to plan the operating layout and move manufacturing facilities for telephone sets to a new building with 850,000 sq. ft. of floor space. Just 17 days after the engineers received the key to the door, the first new telephones were turned out there.

Another job called for rearrangement and retooling in 106 big factory sections in a single Western Electric Works. Within two weeks, 19 sections were throbbing with civilian telephone manufacture—within a month, 35 sections were on peacetime products—three and one-half months later, production was approaching pre-war levels.

As additional space and new machinery become available, production for the Bell System is expected to hit an all-time high.

Distributed by Graybar Electric Company

Western Electric

TELEPHONE APPARATUS AND CABLE

ANNUAL REPORT

of A. T. & T. Company

THE board of directors of the American Telephone and Telegraph Company announced on February 26 their annual report of 1945, which included many facts and figures of interest to all telephone people. Because of the importance of AT&T in telephone activities we publish the following excerpts from the annual report, their sixty-first:

Gain in Telephones

As evidence of accomplishment, the gain in telephones in the last quarter of 1945 for the Bell System alone was 560,000, by far the highest in any quarter in history. Increases are currently running at the rate of about 250,000 a month, or 3,000,000 a year, which is more than twice the largest annual gain ever recorded. This record-breaking pace of installation work has already enabled the System to provide service to a substantial proportion of the customers who have been waiting a long time. However, since the end of the war the volume of new orders for service has likewise broken all records, so that the total number of held applications for main service—including those just added to the waiting list—is still very large. By the end of 1945, this total had been reduced to 2,000,000 from the peak of 2,170,000 reached in September. Steady reductions are expected each month, with the emergency program continuing in full force until the last waiting customer has been served and all telephones are once again installing promptly on request.

Use of toll and long distance service also set new records in 1945. Despite construction of much new plant, the load on long distance facilities continued to be excessive. The System is now engaged in the largest intercity construction program in its history and is introducing new types of plant and new operating methods for the purpose of not only restoring but bettering the service standards achieved before the war.

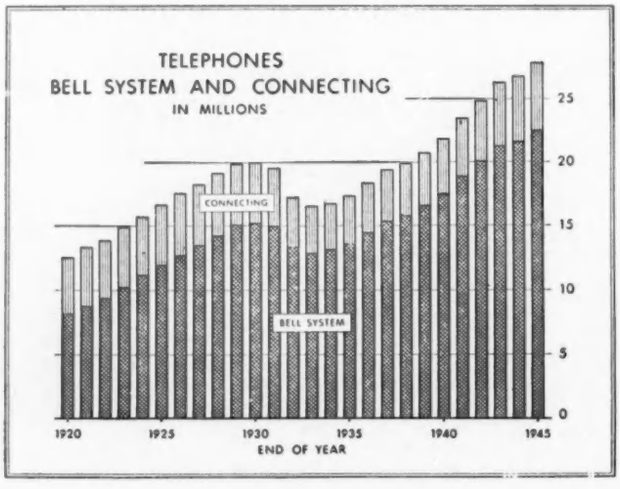
There were 22,445,500 Bell System telephones in service at the end of 1945, an increase of 865,200 for the year, as compared to an increase of 33,700 in 1944.

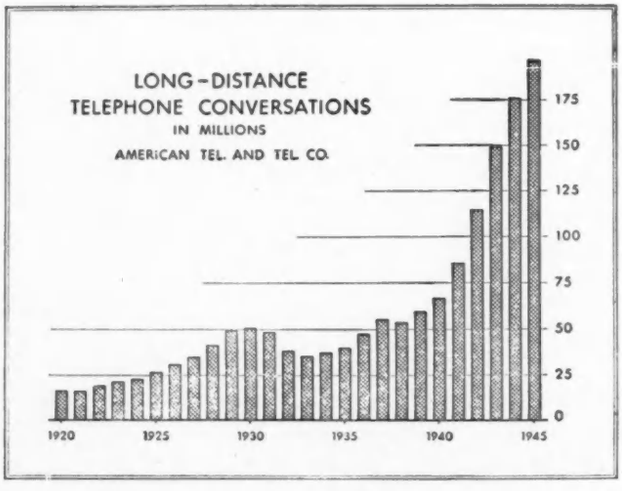
As in previous years, there was cordial and effective co-operation between the Bell System and the 6,000 independently owned connecting telephone companies which operate more than 5,400,000 telephones in all parts of the United States.

The friendly understanding of the public and the willingness of customers to help in meeting telephone problems were important factors—as they were all through the war—in enabling telephone people to overcome difficulties in rendering service.

Earnings

Bell System earnings during the war years have been subnormal. During the four years beginning with 1942, earnings on invested capital averaged only 5.5 per cent, the lowest in the history of the System, except during the worst years of the depression in the early 1930's. With the volume of business and operating revenues at record levels in 1945, earnings on the total invested in the business were still only 5.5 per cent.





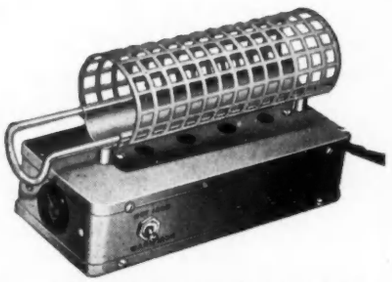
DRAKE — *A NAME TO REMEMBER for RELIABLE SOLDERING EQUIPMENT*

Through 25 years of soldering iron manufacturing, Drake has developed soldering products that set new high standards of quality and long-lived performance.

DRAKE No. 400, for example, is ideal for work in small places—weighs only 8 ounces and is only 9 inches long, yet it is a 60-watt iron.

DRAKE No. 600-10, is conservatively rated at 100 watts, but is only 10 inches long.

DRAKE SOLDER POTS are available in 150 and 300 watt ratings to meet varying needs.



DRAKE HEAT CONTROL is a fool-proof device for keeping idling irons ready for quick use.

*GraybaR QUALITY SINCE 1869 *REG. U.S. PAT. OFF. — Distributed by *GraybaR ELECTRIC COMPANY

The name DRAKE means utmost value—your assurance of long, economical usage.

DRAKE ELECTRIC WORKS, INC.
3656 LINCOLN AVE. CHICAGO 13, ILL.

YOU CAN DO BETTER WORK

or

YOU CAN HAVE WORK DONE BETTER

by having an experienced Contracting and Engineering Organization do your work than by doing it yourself!

GUSTAV HIRSCH ORGANIZATION

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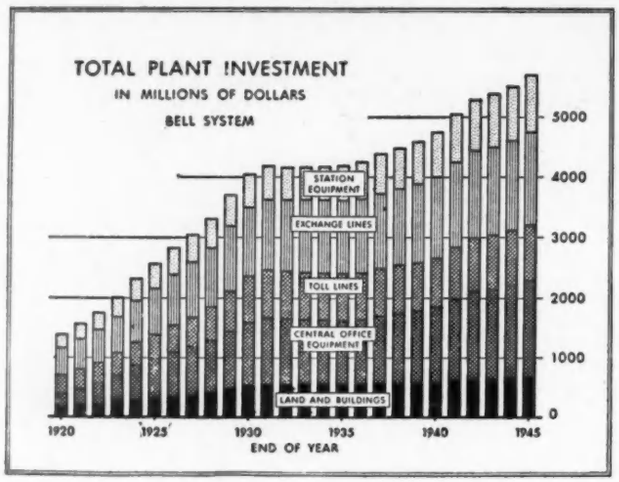
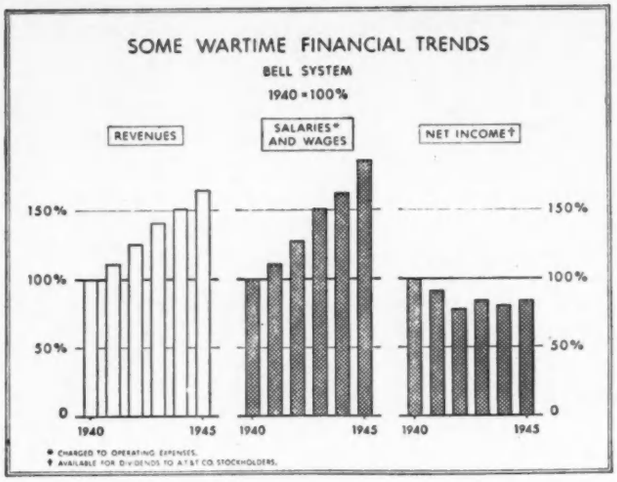




The Bell System will require substantial amounts of new capital to finance the construction program which lies ahead of some two billion dollars to be spent as rapidly as it can get equipment and material manufactured and put in service.

Service

The number of toll and long distance messages in 1945 was about 1,543,000,000 or 13.2 per cent above 1944. Long distance conversations handled by Long Lines Department of the Company increased to nearly 200,000,000 about 11.6 per cent above 1944. Notwithstanding this large increase in volume, long distance calls were handled at almost the same average speed as in 1944. Nearly 85 per cent were put through while the customer remained at the telephone and 95 per cent within less than ten minutes. This is not up to pre-war standards and every effort is being made to improve it. The speed of service on teletypewriter exchange calls, which interconnect the typewritten word as telephone calls do the spoken word, was improved to 1.5 minutes, about the same as before the war.

Despite shortages and other handicaps during the war, the rate of plant troubles reported by customers remained low in 1945 and 95 per cent were cleared on the day reported.

Plant and Facilities

Total expenditures for new construction were $255,000,000 in 1945, compared with $170,000,000 in 1944 and $154,000,000 in 1943. Exchange plant construction, including installation of equipment at customers' premises, accounted for $165,000,000 of the 1945 expenditures and $90,000,000 went into additional toll and long distance circuits and associated switching equipment.

Investment in Bell System telephone plant at the end of the year totaled $5,702,057,000, an increase of $189,662,000 during 1945. Depreciation and amortization reserves were $2,051,763,000, or 36 per cent of the plant investment.

Conservation of scarce materials, to provide for war needs, continued to be necessary throughout a large part of the year. While War Production Board restrictions governing the use of many of these materials were subsequently lifted, lead, antimony, tin and crude rubber, all of which are important constituents of the materials required for telephone plant, were still in short supply at the end of 1945 and continued under Government control.

BELL SYSTEM STATISTICS

	Dec. 31 1925	Dec. 31 1930	Dec. 31 1935	Dec. 31 1940	Dec. 31 1945	Increase During 1945
Number of telephones (a)	11,909,578	15,187,296	13,573,025	17,483,981	22,445,519	865,174
Number of central offices	6,147	6,639	6,896	7,052	7,374	32
Miles of pole lines	394,529	428,212	407,454	399,838	420,009	5,591
Miles of wire:						
In underground cable	27,769,000	45,116,000	47,639,000	54,339,000	60,759,000	841,000
In aerial cable	12,835,000	23,777,000	26,425,000	30,307,000	33,966,000	609,000
Open wire	4,339,000	5,231,000	4,562,000	4,660,000	5,034,000	81,000
Total	44,943,000	74,124,000	78,626,000	89,306,000	99,759,000	1,531,000
Av. daily tele. conversations* (b)	50,141,000	64,034,000	60,290,000	79,303,000	90,548,000	4,489,000
Total plant	$2,566,809,000	$4,028,836,000	$4,187,790,000	$4,747,674,000	$5,702,057,000	$189,662,000
Operating revenues*	$ 737,560,000	$1,075,228,000	$ 919,116,000	$1,174,322,000	$1,930,889,000	$161,185,000
Taxes*	$ 58,113,000	$ 84,732,000	$ 94,507,000	$ 184,770,000	$ 399,917,000	$(17,552,000)†
Number of employees (c)	292,902	318,119	241,169	275,317	387,300	49,437
Number of Am. Tel. and Tel. Co. stockholders	362,179	567,694	657,465	630,902	683,897	15,884

† Decrease. *For year ending December 31.

(a) Excludes private line telephones numbering 97,284 on December 31, 1945. Including telephones of about 6,000 connecting companies and more than 60,000 directly and indirectly connecting rural or farmer lines and systems, the total number of telephones in the United States which can be interconnected is approximately 27,850,000.

(b) For the year 1945 there were approximately 85,877,000 average daily local conversations and 4,671,000 toll and long distance conversations, an increase of 4.8% and 13.2%, respectively, over the year 1944.

(c) In addition the Western Electric Company and the Bell Telephone Laboratories had 87,227 employees on December 31, 1945.

Additions to toll and long distance circuits in 1945 were the largest ever made in one year and amounted to two and one-half million miles, but even this was not sufficient to catch up with the continually increasing demand. At the end of the year about four million additional circuit miles were still needed to restore service to normal.

Work is moving ahead steadily on an experimental radio relay system between New York and Boston, of a type suitable for telephone or television transmission and plans have recently been made for the construction of a similar system between Chicago and Milwaukee. Present indications are that radio relay systems, as well as coaxial cable and possibly other methods, will play an important part in the extension of Bell System facilities capable of carrying television as well as telephone service.

Rates

While prices of most things increase during the war years, telephone rates did not. On the contrary, long distance interstate rates have been reduced substantially. Viewing Bell System earnings as a whole there is nothing in the present or near future outlook that would justify any rate decreases whatever. Earnings on the interstate portion of the business have been abnormally affected by the extraordinary volume of long distance calls and by the temporary overloading of the long distance plant due to shortages of new equipment during the war period. This interstate business is under the exclusive regulatory jurisdiction of the Federal Communications Commission which has insisted that earnings on such business should be considered by themselves, regardless of overall System earnings.

During 1945, two major reductions in rates for the services were agreed upon. On July 1, reductions amounting to $21,000,000 annually were made on the longer haul traffic. For instance, the maximum rate for any three-minute station-to-station call from any point to any other point in the United States was reduced from $4.00 to $2.50. In November, further reductions in rates for certain interstate services were agreed upon, to be effective February 1, 1946, amounting to over $20,000,000 annually.

Rural Telephone Service

The Bell System has made a substantial start on its announced pro-

STROMBERG-CARLSON
RECOMMENDS—

The
CHURCHILL
No. 100 Folding Door
TELEPHONE BOOTH

Booth provides comfort and privacy for your customers. You will find them repeatedly returning to use your **CHURCHILL** Booth and increase pay station business.

It is constructed as a single unit and equipped with a reinforced back panel for mounting a wall telephone or coin collector.

The **CHURCHILL** Booth is made of selected white oak and is available in light or medium oak in a satin finish.

Included as standard equipment are electric light and automatic electric ventilator.

Overall height is 84¾"; width, 29"; depth, 30½". Shipped knocked down and crated.

Illustrated literature available.

SUB-CYCLE
"MASTER"
RINGING CONVERTER
No Moving Parts . . .
Nothing to Adjust

Sub-Cycle brings to the telephone field an exclusive development in an ***alternating current*** Power Ringing Converter which fully meets the requirements of operating companies.

It produces a powerful ringing current entirely independent of frequency variations in the commercial power supply.

Economical and quiet in operation, it does not interfere with radio and requires no routine maintenance.

Available in 6 models suitable for loads required by small P.B.X.'s or large central offices.

Output capacities 7½ to 45 watts.

STROMBERG PROGRESS IN TELEPHONY CARLSON

STROMBERG-CARLSON COMPANY
Factory and General Offices: Rochester 3, New York, U. S. A.
Branch Offices: Chicago, Kansas City, San Francisco, Toronto

STROMBERG-CARLSON *Recommends...*

DEFY THE ELEMENTS

HEMINGRAY No. 10—
The exchange line pony with double groove. Standard on many telephone lines.

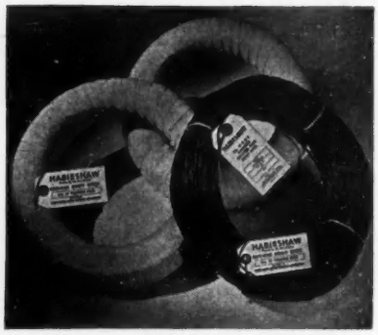
HEMINGRAY INSULATORS are carefully designed to withstand the elements.

Experience has shown Hemingray Insulators never fail to render dependable, long-life service. That's why leading telephone companies have adopted Hemingrays as standard equipment.

Many of these famous insulators are still in service after 20, 30—and even 50 years.

The exacting step-by-step quality production control insures long life in every Hemingray Insulator.

HABIRSHAW



No. 17 Bronze Drop Wire

Distributed Exclusively by
STROMBERG-CARLSON

High strength bronze conductor . . . expertly blended synthetic rubber insulation . . . soft unbleached cotton braid, thoroughly saturated to provide a long-lived moisture-resisting covering.

A Quality Product Made by

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gram to extend telephone service to another million customers in rural areas in the next three to five years. The increase in 1945 in the number of rural telephones was next to the largest ever achieved, in spite of the limited facilities and manpower available.

Studies on the ground were completed in about 1,500 representative rural exchanges throughout the System to determine the extent of the rural markets and the amount and type of plant required. Likewise, the views of thousands of rural customers were obtained regarding their service preferences.

Development of improved and more economical methods of providing rural telephone service has been advanced substantially. Activities to improve the quality of rural service were also started, including reducing the number of parties on lines, improving transmission and installing the latest types of telephone instruments.

Two field trials of a rural power line carrier telephone system were started in the latter part of the year. These trials form part of the Bell System's joint programs with the Rural Electrification Administration and private power companies to determine the feasibility of transmitting speech and electric power simultaneously on the same wires to provide telephone service to farms at a distance from existing telephone lines.

In co-operation with the Rural Electrification Administration and private power companies, trials were also started on the use of new methods and materials which may make it practicable to use the same poles for both telephone wires and high voltage power wires in rural areas.

Toll Line Dialing

As one of the postwar projects of the Bell System, it is planned to introduce methods and equipment which will enable long distance operators to dial calls directly through to the called telephone even though it be at the other side of the continent. The result is expected to be improvement in speed, accuracy and reliability of long distance service and in overall economies of operation.

The plan provides for the inclusion of central office of independent connecting telephone companies which desire to participate. About five per cent of Bell System toll switchboard calls are already handled by direct operator dialing in limited areas.

Conestoga Tel. Expands

The purchase by the Conestoga Telephone & Telegraph Company, Birdsboro, Pennsylvania, of the franchise and assets of the Mountain Telephone Company has been approved by the utility commission, and Conestoga Tel. & Tel. took over the formal operation of the Mountain's 825 telephones, lines and three exchanges as a part of the Conestoga system on March 1, with no changes in the operating staff.

The present magneto system of the Mountain company will remain intact until the Conestoga's Boyertown exchange is converted into an automatic system early in 1948.

The acquiring of the rural company, whose exchanges are located in Bally, Topton and Sassamansville, will mean a step forward in the improvement of the phone service for these communities. The management of the Conestoga Company plans extensive improvements throughout the system in this entire area.

The new Boyertown exchange building to be erected as soon as material is available, will involve an outlay of $25,000. The installing of up-to-date automatic central telephone equipment, will mean an additional $65,000 investment, and the placing of the new automatic phones in the homes of the subscribers will mean a further outlay of $32,000, a total outlay of approximately $122,000, according to John K. Stoltzfus, general manager.

It was in 1928 that the Conestoga company purchased the telephone line in the Boyertown area from the Bell Telephone Company, at an outlay of $25,000. The subscribers then numbered 420. In October, 1929, the magneto system was changed to the common battery service now in use. The Conestoga subscribers of the Boyertown exchange now number over 1,300.

Free Catalog on Relays

A new catalog on "Aerotrol" Relays has just been completed and is ready for distribution by Cook Electric Company, Chicago 14, Illinois.

"Aerotrols" are small size relays that were designed for and used extensively in aircraft during the war and are now available to all industry.

The catalog is well illustrated throughout its 24 pages and is pleasingly done in three colors. It is the type of booklet many telephone engineers will want to keep in their library of new and useful products. Postcard requests to Cook Electric Company or Telephone Engineer will bring your catalog of "Aerotrol" relays at once.

STROMBERG-CARLSON Recommends...

COVERING THE GLOBE WITH ARMSTRONG'S

"Whitall Tatum" GLASS INSULATORS

From the tropics to the northlands, Armstrong's "Whitall Tatum" glass insulators are giving trouble-free service. Meeting all A.S.A. and E.E.I. standards, they defy severe temperature changes.

Automatic machinery plus precise laboratory control guarantees uniformly high electrical and physical properties. Batch materials are rigidly checked. Ring-section studies assure uniformity of the glass while polariscope examinations certify that annealing has cancelled internal stresses and strains.

Crystal clarity of the glass reduces malicious breakage to a minimum. Careful gaging of the pin cavity results in a true, snug pin fit.

For samples and full information, write:

RAYTHEON RECTICHARGERS

FOR DEPENDABLE POWER IN UNATTENDED STATIONS

Because Raytheon RectiChargeRs keep batteries fully charged... are entirely automatic in operation . . . have no moving parts...and require no maintenance, they are ideal for unattended locations. Simply plug them into the AC input and connect the output to the batteries . . . adjust the charging rate . . . and from then on RectiChargeRs will—

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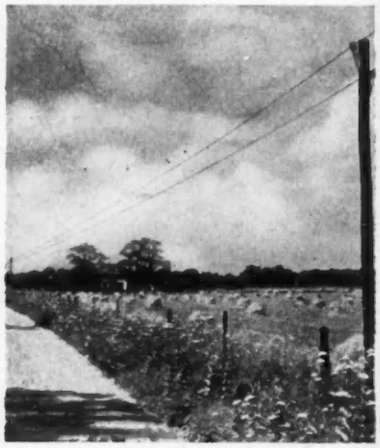

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Participate in New Rural Charge Plan

The Trumansburg (New York) Home Telephone Company is one of several Independent telephone companies in New York that has joined in a program to make it easier for rural residents to avail themselves of telephone service. H. H. Griswold, general manager of the company, reports that although their plan is already in effect some delays in rural line extensions might be encountered due to inability to obtain material as rapidly as desired.

Under the new plan the company will allow one half mile of construction along the highway for each applicant without any construction charge. For rural line extensions beyond the construction allowance of one half mile per applicant, a small construction charge will be applied. In the event more than one applicant is subject to construction charges, such charges will be divided equally among the group.

It is estimated that under the new plan only a small percent of rural families desiring telephone service have to pay a construction charge. In many cases telephone service can be installed for only the regular service construction charge.

Details of the new and liberal plan covering rural construction charges in New York State were reported in the February 1 FORTNIGHTLY TELEPHONE ENGINEER on page 32.

New Managers

William A. McCracken, formerly asistant works manager of Kellogg Switchboard and Supply Company, Chicago has been appointed works manager. Mr. McCracken succeeds James H. Kellogg, former vice-president and works manager, who was recently elected president.

R. H. Carlsen has been appointed sales promotion manager of the rapidly expanding Koiled Kord division of Kellogg Switchboard and Supply Company, Chicago.

In his new position Mr. Carlsen will work closely with R. C. Krueger, manager of the Koiled Kord division, on plans for aiding distributors and jobbers in national merchandising of the new Kellogg appliance cord sets.

Sales of Koiled Kords, which have been developed for use with household and industrial electrical appliances, are rapidly increasing in volume as the merchandising plans of the company expand and as shipments to the trade continue to increase.

Royalty-free License on Carrier Equipment

A royalty-free license under Bell System patents to make equipment developed by the Bell Telephone Laboratories for sending telephone conversations over rural electric power lines has been offered to manufacturers of telephone equipment in this country, the A.T.&T. announced February 27.

The development, known as the rural power line carrier system, permits the transmission of both telephone conversations and electric power over the same line at the same time and is intended for use in rural areas where there may be electric power lines but no telephone wires.

Rural line carrier is one of several methods the Bell System is perfecting for use in attaining its objective of extending telephone service to a million additional farm families within the next few years.

As soon as developments and field trials now under way have progressed sufficiently, the apparatus will be manufactured and in a letter to W. C. Henry, president of USITA, announcing this, Keith S. McHugh, vice-president of A.T.&T., also stated that "at the same time we shall be prepared to extend to manufacturers in this country a royalty-free license to make such power line carrier apparatus insofar as Bell System patents are involved and to sell it for use in the United States for the purpose of extending telephone service directly from a central office of a telephone company to the premises of its rural customers, including service line customers."

Development of rural power line carrier was undertaken prior to the war. Preliminary tests were interrupted by the war and have now been resumed. A public test is being conducted over a rural power line near Jonesboro, Arkansas. Bell System and Rural Electrification Administration engineers are cooperating in this trial.

A similar test is under way jointly with the Alabama Power Company at Selma, Alabama. Both trials are progressing satisfactorily and were reported and illustrated in the February 1 issue of FORTNIGHTLY TELEPHONE ENGINEER.

Although power line carrier is expected to serve a real purpose in extension of rural service, telephone engineers point out that most farm families will be served by conventional telephone wires. More than 80% of rural residents live within reach of existing telephone pole lines by means of which they can be provided service.

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Chapter 11
Section 2

Basic Theory of Frequency Modulated Systems

By B. C. BURDEN
Technical Consultant
Lincoln, Nebraska

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The Discriminator

The second unit in an FM receiver which differs from the elements of an AM receiver is the *discriminator*. Its function is to convert the frequency modulated carrier wave after it has passed through the I.F. amplifier into a replica of the original audio frequency components. It thus functions to produce the same effective result as the detector, (demodulator) in an amplitude modulated receiver. It of course operates in an entirely different manner than a detector stage of an AM receiver.

Essentially a discriminator is an impedance whose magnitude varies with the impressed frequency. Thus frequency variations are converted into impedance variations and these in turn bring about the voltage variations which are used to actuate the audio portion of the FM receiver.

There are a variety of discriminator circuits. However, they all produce the same end result. Fig. 150 illustrates one common type of discriminator circuit used in FM receivers.

Action in this circuit is as follows: The output of the I.F. amplifier is coupled to the primary of an RF transformer whose secondary winding terminates on the two plates of the twin-diode discriminator tube. The audio voltage developed by the FM signal in passing through the discriminator appears across a voltage divider network in the cathode circuit of the twin diode. When the incoming FM signal from the last I.F. tube is unmodulated, the voltages developed across the two halves of the secondary winding are 180 degrees out of phase with each other. This results in rectified currents across the resistance network in the cathode circuit (resistors R_1 and R_2) which are of equal magnitude and opposite polarity. Thus they cancel out and zero audio frequency voltage appears across the audio output circuit.

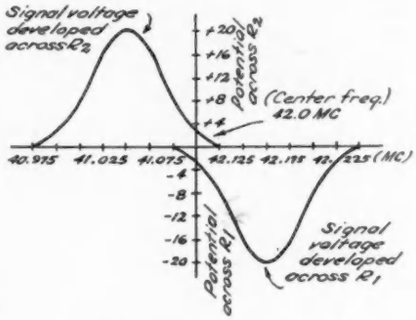


Fig. 151—Curves showing manner in which the discriminator converts frequency variations into audio variations.

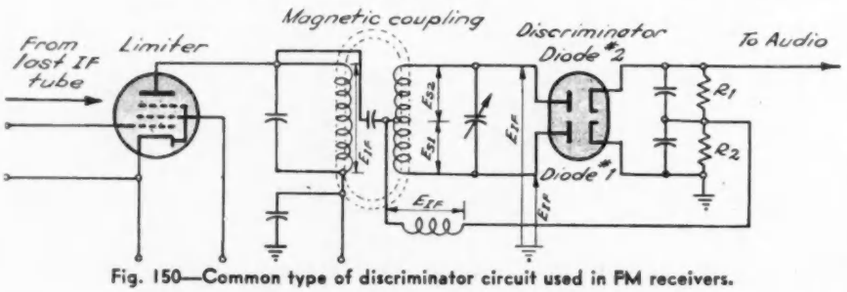


Fig. 150—Common type of discriminator circuit used in FM receivers.

When the FM signal is modulated, the phase relationship between the two voltages developed across the two halves of the secondary winding is no longer 180 degrees out-of-phase, hence unbalanced currents flow in the two halves of the resistance network. This unbalanced current condition results in a voltage being developed across the resistance network. This voltage corresponds to the audio frequency component impressed on the FM wave at the transmitter.

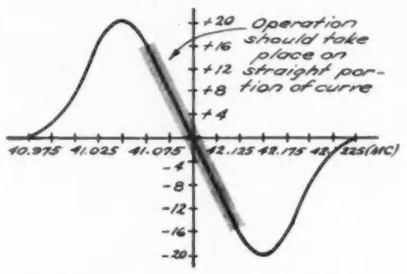


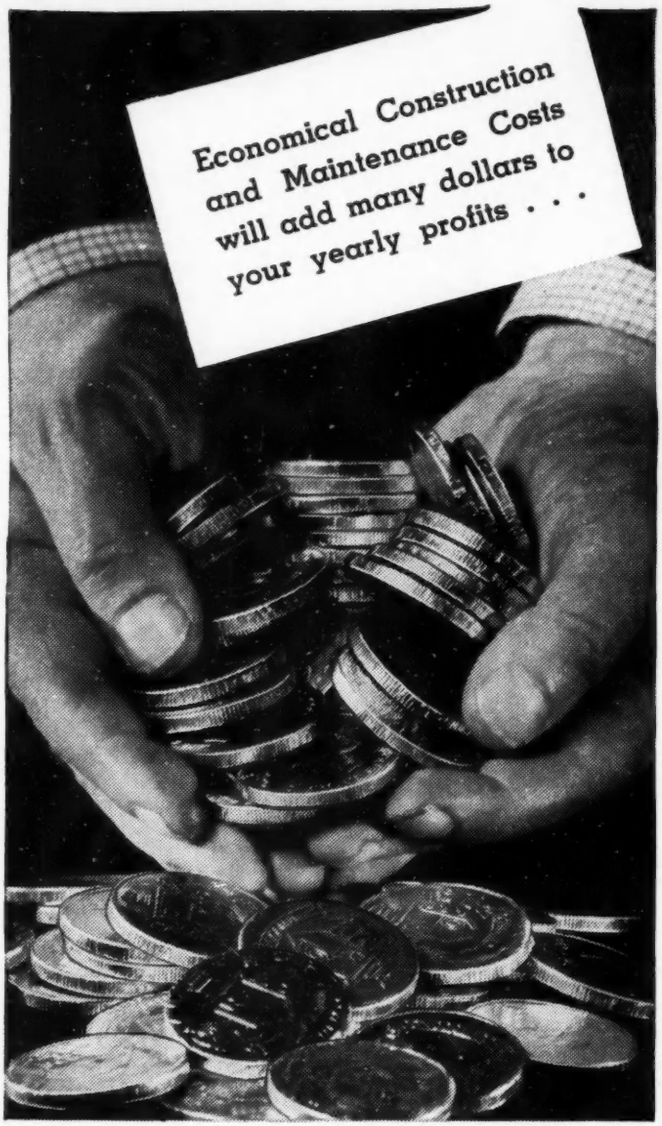
Fig. 152—Combined result of voltages developed in two halves of discriminator output.

Fig. 151 shows how the d-c voltages which are developed across resistor R_1 and R_2 appear when considered individually. When their resultant (combined) effect is taken into account, the result is as shown in Fig. 152. It should particularly be noted that for high quality reception the frequency deviations of the incoming signal should not exceed a value which permits operation on the straight portion of the curve as shown between point *A* and *B*.

Design Features of the Discriminator Circuit

Discriminator circuits should be so designed that a minimum distortion to the audio signal takes place. This means that operation must take place over the straight portion of the characteristic curves shown for the two diode units. Discriminators are normally designed so that they are linear over a wider range of frequencies than the frequency swing of signals which they are normally called upon to handle. This is desirable as it permits good reception without distortion even though the receiver may not be tuned exactly to the exact frequency of the incoming carrier signal.

Normally the FM signal applied to the discriminator input has a constant amplitude. In handling weak signals the amplitude of all of the impressed frequency components may not be the same. That is, some frequencies may have



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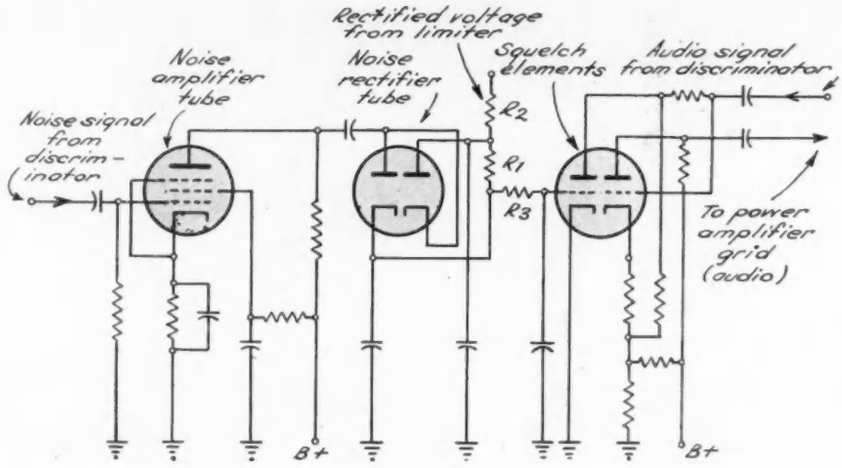

Fig. 153—Typical squelch circuit used in commercial FM receivers.

higher amplitudes than others. This lack of uniformity in amplitude in the various frequencies may be due to poor design in the radio receiver circuits. In effect this shortens the straight portion of the discriminator characteristic curves and this means of course that distortion will appear in the audio output.

Squelch Circuits

The frequency modulated receivers used in commercial applications are usually equipped with what are known as *squelch circuits*. The purpose of a squelch system is to quiet the receiver when no carrier signal is being received. This is particularly desirable in connection with such services as police mobile radio, R. R. radio, telephone systems, etc. The squelch circuit causes a receiver to be absolutely quiet until the station is called by some other station.

A typical squelch circuit is shown in Fig. 153. The circuit shown requires two auxiliary tubes which operate in such manner as to bias the audio tube to cut-off when no carrier is being received.

This circuit operates by virtue of the fact that when no signal is being received on an FM receiver a high noise level is present. This noise is picked off the discriminator and fed through a *noise amplifier tube*. After undergoing amplification the noise currents are passed through a *noise rectifier tube* which develops a substantial d-c voltage across a bias resistor. This voltage is used to positively bias the grid of the *squelch control section* of the audio and squelch tube. At the same time a voltage is fed to this same grid from the limitor tube. This voltage tends to bias the grid negatively.

The difference voltage is of such value as to cause the squelch section of the tube to draw plate current. This biases the grid of the audio section of the tube to cut-off and thus silences the audio section.

When a carrier is received by the set, the positive voltage from the noise rectifier is reduced and the negative voltage from the limitor is increased. The resultant voltage then becomes sufficiently negative to bias the grid of the squelch tube to cut-off which removes the cut-off voltage applied by this tube to the audio grid.

The audio section then operates in a normal manner.

Noise pulses of short duration are not sufficient to open the squelch circuit due to the time constant involved.

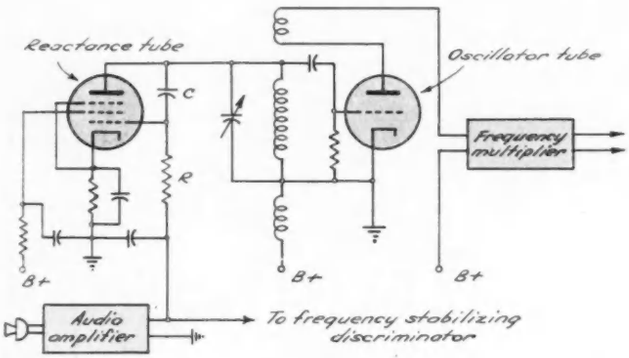

Fig. 155—Use of reactance tube principle to control frequency.

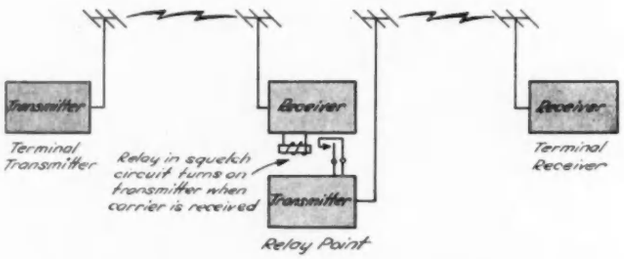

Fig. 154—Use of relay in squelch circuit to turn on transmitter in automatic relay system.

Commercial receivers used for various purposes are often equipped with a relay in the squelch circuit. The relay is so arranged that it may be used to turn a transmitter on. This is a desirable arrangement when an FM carrier channel is applied to a radio relay system as is shown in Fig. 154.

AVC Circuits in FM Receivers

Some frequency modulated receivers are equipped with automatic volume control circuits while others are not. The limitor of an FM system functions in a somewhat different manner than the automatic volume control circuit but it accomplishes somewhat the same end result. There is a good possibility that

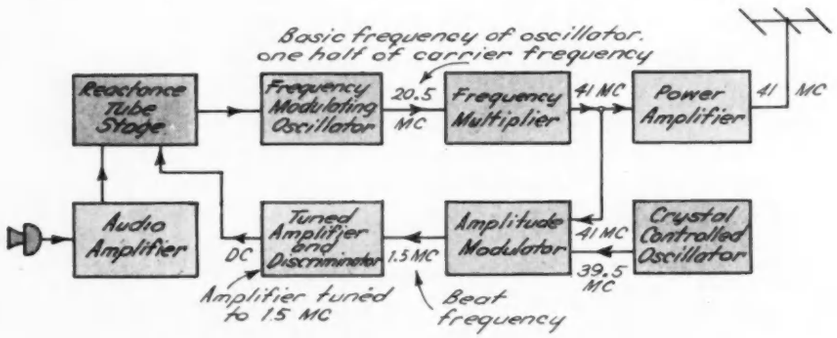

Fig. 156—Block diagram of frequency modulated transmitter of reactance tube type.

AVC circuits will not be used in many FM receivers.

Frequency Modulated Transmitter Circuits

Let us next examine and study the transmitter circuits used with frequency modulation systems. A well designed FM transmitter should have the following characteristics: (1) the center or carrier frequency should be stable and should not drift from the assigned value, (2) the amplitude of the output wave should not vary as the result of modulation, (3) the frequency deviation of the output wave will vary in direct proportion to the amplitude of the modulating voltage and at a rate equivalent to the frequency of the audio modulating voltage.

FM transmitters are somewhat more complicated than the amplitude modulated type. In an amplitude modulated transmitter a quartz crystal can be used in a simple manner to control the output frequency as only a single frequency is involved. The quartz crystal can also be used to control the frequency of an FM transmitter. But complications are introduced by the necessity of varying the carrier frequency in some manner since it is by this means that the intelligence is transmitted.

Two Types of FM Transmitters

Two methods are in common use for producing frequency modulated signals. These are known respectively as: (1) the reactance tube method, and (2) the phase shift method.

Modulation is accomplished in the reactance tube method by using a vacuum tube as a reactance in the tuned circuit of a control oscillator. A vacuum tube can be used as a reactance element (either capacitative or inductive) by using a phase shifting network in this grid and plate circuits of the reactance control tube so that the plate current lags or leads the plate voltage by 90 degrees. Whether or not the current is lagging or leading depends on the manner of connecting the phase shifting network. If the plate circuit of the reactance control tube is connected across the tuned circuit of a self excited type oscillator, the *apparent reactance* of this tube due to the leading or lagging currents can be used to change the constants of the tuned circuit in the same manner as if we applied a variable capacitance or inductance. The use of a reactance tube to change frequency is shown in Fig. 155.

The amount of this shift in frequency depends on the magnitude of the a-c plate current which flows in the tuned circuit inductance to which the control reactance tube is connected. The plate

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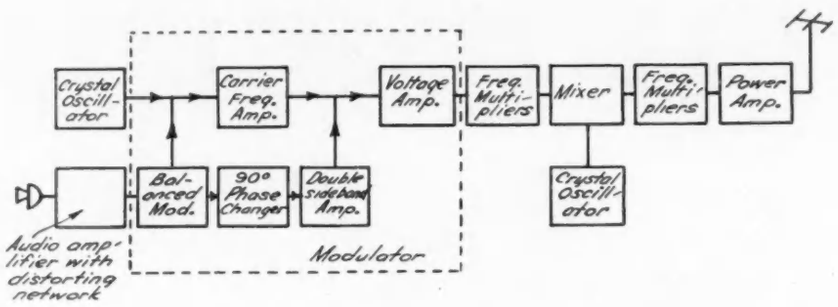

Fig. 157—Block diagram of phase shift type of FM transmitter.

current is under the control of the impressed audio voltage applied to the grid of the reactance controlled tube. The extent of the frequency excursions brought about by the reactance tube is controlled by the amplitude of the audio voltage impressed on the reactance tube. The rapidity with which the frequency excursions take place is the same as the frequency of the impressed audio modulating voltages.

Arrangement in Commercial Reactance Tube FM Transmitter

In commercial circuits employing the reactance tube principle, auxiliary equipment is necessary to prevent the center frequency (carrier) from drifting away from its normal value. This is accomplished by means of a discriminator type of circuit which applies a *correcting control voltage* to the reactance tube oscillator circuit.

The block diagram of a complete frequency modulated transmitter of the reactance tube type is shown in Fig. 156 In the example given, the crystal controlled oscillator produces a basic frequency of 39.5 megacycles. This is fed into an *amplitude modulator* as is also the big basic carrier frequency of 41 megacycles which is produced by a frequency modulated oscillator of the self-excited type. These two frequencies mix in the modulator to produce a difference frequency of 1.5 megacycles at the output of the amplitude modulator. This is fed through a *tuned amplifier* and a *discriminator*. The latter is so adjusted that no control voltage is generated in its output when the impressed frequency is exactly 1.5 megacycles. But if the frequency departs in either direction from this value, a control voltage is generated. This control voltage is applied to the grid circuit of a reactance tube and brings about a correcting change in the tube reactance which adjusts the self-excited frequency modulating oscillator in such manner as to bring its output frequency back to its basic value of 20.5 megacycles. Thus crystal control of the radiated FM wave is obtained by the indirect means just explained.

The reactance tube is of course modulated in the usual manner by the audio input and causes the frequency of the frequency modulation oscillator to vary above and below the center frequency of 20.5 megacycles. This modulated carrier frequency passes through a *frequency doubler* whose output is 41 megacycles. It then passes through a *power amplifier* into the antenna system.

In this type of system a filter is required in the discriminator output circuit. Its purpose is to prevent the normal frequency shifts due to modulation from affecting the control circuit. This is accomplished by using a filter having a slow acting time constant which makes it unresponsive to the rapid changes in frequency due to modulation.

The Phase Shift Method of Frequency Modulation

The *phase shift method* of frequency modulation is somewhat more difficult to understand than is the reactance tube method. Both systems produce the same results, viz., a deviation in the carrier frequency whose magnitude is proportional to the amplitude of the impressed audio signal and whose rate of variation is proportional to the frequency of the audio modulating signal.

Stated in its simplest terms frequency modulation by the phase shift method is accomplished by mixing in a modulator stage the audio input and a fixed frequency from a crystal controlled oscillator. The resultant is then passed through a *90 degree phase shifting circuit* and then combined with the original crystal controlled oscillator frequency which is passed through a voltage amplifier.

The net effect of the action just described is to bring about a small variation in the frequency obtained from the crystal oscillator. The action in a phase shift FM transmitter is very difficult to describe or picture graphically without a complicated mathematical treatment. However, reference to the block diagram of Fig. 157 should enable you to obtain a reasonably good concept of the action that takes place in a transmitter of this type.

The block diagram shows a simplified version of the phase shift type of frequency modulated transmitter. In the example shown, a 400 kilocycle *crystal controlled oscillator* feeds into a *voltage amplifier* and also into a *balanced modulator*. The audio modulating source feeds into a special *distorting amplifier* and then into the balanced modulator. The balanced modulator creates sidebands in much the same manner as does

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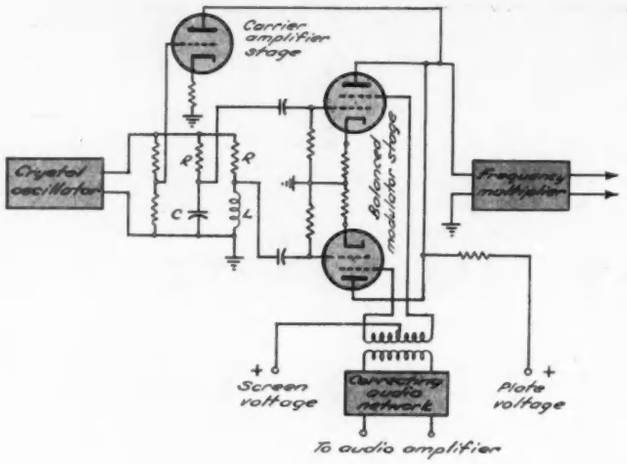


Fig. 158—Simplified circuit of phase shifting portion of one type of phase shift FM transmitter.

any balanced modulator in which the carrier frequency cancels out leaving only the sidebands present in the output circuit. The sideband frequencies are passed through a *90 degree phase shifting circuit* the output of which is connected to the output of the voltage amplifier. As previously stated, the net result of this action is to produce a frequency modulated signal. The special distorting audio amplifier contains networks which make its response inversely proportional to the frequency. That is to say, as the frequency increases, the amplification decreases. This is necessary to insure that the frequency deviation of the carrier is independent of the modulation frequency and proportional only to the magnitude of the impressed audio signal.

The actual frequency deviation produced on the 400 kilocycle crystal control signal is relatively small (only a few cycles) in itself and the signal must be passed through a number of *multipler stages* before it reaches the final amplifier in order to build up the frequency deviation in the final carrier to the desired value. A simplified circuit of the modulating portion of an FM transmitter of the phase shift type is shown in Fig. 158.

Frequency Deviation Multiplication

In a practical phase shift frequency modulated transmitter the maximum phase deviation of the FM voltage wave at the output of the phase shift modulator should not exceed 0.2 of a radian. If a frequency deviation ratio of 1 to 5 is used, then in a typical system having a 75 kilocycle maximum deviation the total phase deviation in such a system would need to be 1500 radians. This would mean a frequency multiplication of 7500. With a crystal oscillator frequency of 200 kilocycles (and this frequency is often used) the output frequency would be 1500 megacycles if the 0.2 of a radian is to be built up to 7500 radians. Hence it is necessary to use *converter* and *mixer stages* to produce the desired deviation frequency.

For example, when an FM carrier of 42 megacycles is to be obtained, the arrangement would be as shown in Fig. 159. In this circuit a second crystal controlled oscillator is used and at the output of mixer tube No. 1 a lower frequency is obtained, but *the frequency deviation remains the same.* After passing through mixer No. 2, the two frequencies combine to produce a still lower frequency but with a multiplication of the frequency deviation. The signal then passes out through additional multipler stages to produce the desired channel carrier frequency and final deviation.

(Part 1 of Chapter 12 will appear in the April 1 FORTNIGHTLY TELEPHONE ENGINEER.)

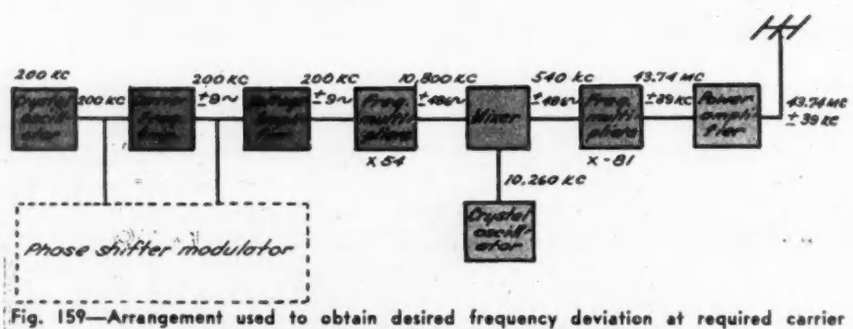


Fig. 159—Arrangement used to obtain desired frequency deviation at required carrier frequency in phase shift type of FM transmitter.

Examination Questions Chapter 11—Basic Theory of Frequency Modulated Radio Systems

1—What are the three basic types of modulating systems used in radio transmission?

2—State the principal advantages and disadvantages of the FM system of modulation as compared to the AM system.

3—What are the three groups of frequencies of principal interest to telephone companies at the present time?

4—Explain briefly the manner in which audio intelligence can be carried by a frequency modulated wave.

5—What determines the width of the frequency band required for an FM channel?

6—Why are "guard bands" needed in connection with FM channels?

7—Describe in your own words the action that takes place in an FM receiver and illustrate by means of a block diagram.

8—What advantage is gained by the use of a "limitor stage" in an FM receiver?

9—Explain in detail the action of the "discriminator" in an FM receiver.

10—Why would it be desirable to use "squelch circuits" on FM receivers for such applications as police radio, telephone urban mobile installations, highway emergency mobile units, etc.?

11—Name the two basic systems used to obtain frequency modulation in FM transmitters.

12—Explain briefly the operation of the "reactance tube type" of FM transmitter.

13—Explain briefly the operation of the "phase shift type" of transmitter.

14—Why does the "phase shift type" of FM transmitter need auxiliary converter mixer stages?

$1,050,000 Carrier Project

Two hundred and fifty-eight new telephone toll channels, constituting an additional 55,000 channel miles of circuits, were authorized by the FCC last month under a long distance construction project of the American Telephone & Telegraph Co., and the Illinois Bell between Chicago and Minneapolis at an estimated cost of $1,050,000. The project calls for nineteen 12-channel carrier systems.

The additional circuits were needed because of the greatly increased traffic. Between Chicago and Milwaukee there will be 171 additional channels, an increase of 17%; between Milwaukee and Stevens Point, 102 additional channels, a 28% increase; and between Stevens Point and Minneapolis, 55 additional circuits, a 15% increase. For summer traffic an additional carrier system was added between Stevens Point and Rhinelander, Wis.

The Pacific Telephone & Telegraph Co., Southern California Telephone Co. and Bell Telephone Co. of Nevada received approval of a toll construction project costing $1,630,400 between Oakland and Sacramento, Cal.

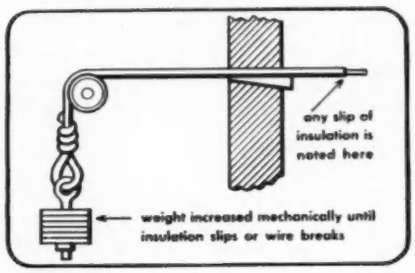
Graybar Appointment

Donald R. Edge has taken over the duties of assistant rural lines sales manager for the Graybar Electric Company, Inc. He is making his headquarters in Chicago.

Mr. Edge has been intimately connected with Rural Electrification Administration activities since 1936, having managed the Union Rural Electrification Administration activities since 1936, having managed the Union Rural Electric Cooperative in Marysville, Ohio which he left to organize and later manage the Central Electric Cooperative, Inc at Parkers Landing, Pennsylvania. It was here that he directed the construction of more than 1,000 miles of rural line serving approximately 4,000 customers. This background of experience coupled with his four year association with the General Cable Corporation not only has made him especially well fitted for his new work, but has also made him constantly alert for improvements in equipment and operating methods. On the theory that there were many problems peculiar to rural system operation he has assisted in the development of materials especially designed for rural service. For the past three years Mr. Edge has cooperated with General Electric Company engineers in a series of field tests which have led to a number of refinements in transformer and line protective equipment.

TELEPRENE
DROPWIRE

ADHESION TEST



Specimen is wedged into solid body similar to method of fastening in field, then submitted to pull.

If adhesion is less than tensile strength of wire, the insulation will slip on wire.

This test proves conclusively that TELEPRENE will not slip in the supporting clamp due to the lack of Adhesion between Conductor and Insulation.

For other outstanding features of Teleprene see our bulletin *"The Story of Teleprene Drop Wire"*

TELEPRENE; the DROP WIRE with the NEOPRENE Synthetic Rubber Outer Jacket

Prices, delivery and samples obtainable through your nearest GraybaR *Office*

Distributed by GraybaR ELECTRIC COMPANY

Order Teleprene by WHITNEY BLAKE Catalogue No.

17TBP-R Reinforced Parallel
17TBP Parallel
17TB2-R Reinforced Twisted Pair
17TB2 Twisted Pair

* *Reg. Applied for, U.S. Pat. Office*

THE WHITNEY BLAKE CO.
New Haven, Conn.
Well Built wires since 1899

Good Light For Good Sight

(Continued from page 40)

special 1.9 volt bulbs. A small and convenient charger permits the cells to be readily recharged, thus insuring maximum light at all times.

Portable Inspection Lights

The portable *inspection type* of light has come into wide use during the war. These lights have also been found to be very useful in connection with central office maintenance. They are used to advantage by PBX maintenance men who work on switchboards in all types of locations. Inspection lights are available in both the battery operated and a-c powered type. The battery powered type is best suited for most telephone purposes. The extension arms are very flexible and resilient and with the small bulb can be used to advantage in the inspection of all types of switchboard wiring. They are particularly useful in checking jack and drop forms and for any situation in which crowded wiring or equipment makes a light of this type useful.

Portable Lights for Mainframes and Company Garages

Indispensable in any telephone exchange is the portable *trouble light* which is used behind mainframes, around switchboards, etc. Although a trouble light can be made from an old socket and an improvised handle, it is hardly to be recommended. There are a variety of types of inspection lights but, in the opinion of the author, the light which best meets the requirements of a central office is one having an insulated guard equipped with a hook and a shield. This type of light with its all-fibre guard eliminates the possibility of shorting out telephone circuits, blowing fuses or shocking the user. This latter point is important as the repairman is constantly working around grounded circuits, and with an uninsulated trouble light the possibility of receiving a dangerous shock is ever present.

Portable Lights

Although it is not often that telephone repairmen are called on to make line repairs at night, when this does happen there is urgent need for a bright spot or flood light of the portable type. There are now available very excellent lamp units that are relatively inexpensive and yet designed to furnish an abundance of light, either in the form of a long range intense narow beam or a broad beam for illuminating a large area. The lamps, which are made especially for telephone and power companies, are equipped with parabolic mirror type reflectors and high intensity prefocused bulbs. They are available both in storage battery operated and dry cell types. Most of them are designed so that the light can be swiveled or rotated in such manner as to project the beam to the top of the pole or to any angle desired. One or more of these units even though used infrequently would quickly pay for itself.

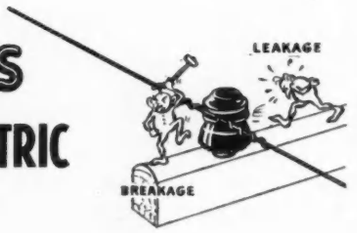
Some companies are using these lights for installation work, particularly when installing wiring in basements or attics. For this purpose the broad beam flood light type is most suitable. Figure 4 shows several types of portable trouble lights made by the Carpenter Mfg. Company of Cambridge, Massachusetts.

Maintenance of Lighting Installation

Due to an unavoidable collection of dust and dirt on lamp fixtures as well as on ceiling and sidewalls, the efficiency of a given lighting installation is constantly deteriorating. The reduction in illumination levels due to dirt is surprisingly large. It is therefore essential that lighting fixtures and lamps be cleaned at periodic intervals. Standard practice with some industrial concerns is to clean the fixtures with a dry cloth every four weeks and to thoroughly wash with soap and water followed by a rinse in ammonia water every three months. In cleaning light fixtures, both the fixture and the lamp should be cool to avoid possibility of cracking. An ammonia rinse for use in cleaning light fixtures can be made from ½ pint of household ammonia to four gallons of water.

Where possible, walls and ceilings should also be washed, repapered or painted at intervals sufficiently close together to maintain them in good bright condition. This is of particular importance where fixtures of the indirect or semi-indirect type are used.

INSULATORS
from AUTOMATIC ELECTRIC
Stay on the Job!



Once installed, insulators from Automatic Electric "stay on the job" . . . fighting rain and sun, heat and cold. They're made by Hemingray or Armstrong—of clear, non-porous glass, carefully annealed for greater strength and long life. And they're carefully inspected for all possible flaws before shipment.

For lower maintenance costs, ***insulate with the best.*** Choose Hemingray or Armstrong—the insulators that "stay on the job." We can supply insulators for any project. Choose yours from the Automatic Electric catalog.

Recommended and Distributed By

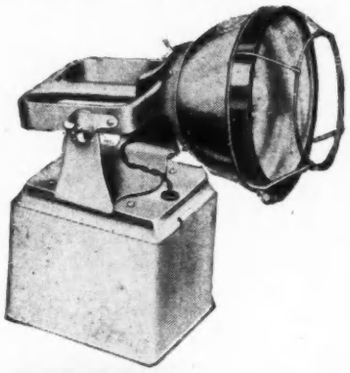
AUTOMATIC ELECTRIC
SALES CORPORATION

1033 WEST VAN BUREN STREET, CHICAGO 7, ILL.

"MASTER-LIGHTS"

● FOR EMERGENCY LIGHTING ●
● AND REPAIR CREWS ●
• SIGNAL AND HAND FLOODLIGHTS for SIGNAL CORPS •
• RECHARGEABLE AND DRY BATTERY LIGHTS •
• REPAIR TRUCK SEARCHLIGHTS •
• WATCHMEN'S RECHARGEABLE LIGHTS • MARINE SEARCHLIGHTS •

Above—Type DBS (5 No. 6 cells)
Below—Type WS (Rechargeable)



TYPE DUL
(Right) has 12 months rechargeable storage battery. Illuminates wide area instantly when other lights fail.

TYPE T & T
(Right) uses 2 No. 6 or telephone dry cells. Gives 10 ft. spot at top of 40 ft. pole, or a nearby flood worklight.

Type T Auto Roof Light for Repair Cars. Very powerful.

CARPENTER MANUFACTURING CO.
"MASTER * LIGHT * MAKERS"
(Cable PORTALITE) 222 Gilman Sq.—Boston 45, Mass.

New Deci. Point Slide Rule

Several new features are now being incorporated into the revolutionary Deci.Point Slide Rule which is the first one, in over 300 years of slide rule history, to place the decimal point at the end of long and intricate computations. It will determine the precise location of the decimal point in involved expressions with results up to 19 places.

The Deci.Point Slide Rule is now being manufactured of light-weight Dowmetal which permits superior accuracy as it is not affected by climatic conditions of heat, cold or moisture. The Deci.Point user enjoys five advantages in the Deci.Point slide rule:

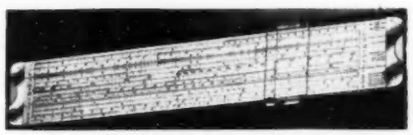
1—Places the decimal point mechanically up to 19 digits or zeros.

2—Same setting of hairline for result also gives readings for cube and square roots, and logarithm of result.

3—Gives 30-inch scale accuracy for cube root.

4—Gives 20-inch scale accuracy for square root.

5—Simplifies slide rule calculations so that relatively complicated expressions can be evaluated and pointed off by users with a limited mathematical background.



With each Deci.Point slide rule a manual is provided covering all phases of slide rule operation as well as decimal point location.

For further information on this rule, send a postcard to New Products Editor, Telephone Engineer Publishing Corporation, 7720 Sheridan Rd., Chicago, 26, Illinois.

Complaint

Tenants of Matsonia Apartments in San Francisco, California, who have received switchboard service through installations in their apartments for over 30 years, were notified recently by the owners, George D. and Pearl E. Geis, operating switchboard, that service would be discontinued. The tenants complained to the Railroad Commission of the State of California, saying they had paid monthly for this switchboard service and would have no telephone service if the board were discontinued; they ask that the Geises file rates with the commission and continue service, or that the Pacific Telephone and Telegraph Company, servicing the apartment supply it. To date a decision has not been issued.

Rate Increase

The Mt. Pulaski (Ill.) Telephone and Electric Company advanced its rates March 1 as follows:

Class of Service Mt. Pulaski	No. of Stations	Net Annual Rates O'd Rate	Present Rate
Individual Business	65	$24.00	$36.00
Individual Residence	287	18.00	21.00
2-Party Residence	5	15.00	18.00
Rural Business	9	24.00	36.00
Rural Residence	241	18.00	21.00
Chestnut			
Individual Business	12	18.00	30.00
Individual Residence	33	18.00	21.00
2-Party Residence		15.00	18.00
Multi-Party Rural	60	18.00	21.00
Latham			
Individual Business	14	18.00	30.00
Individual Residence	38	18.00	21.00
2-Party Residence		15.00	18.00
Multi-Party Rural	100	18.00	21.00

The secret that isn't being kept secret

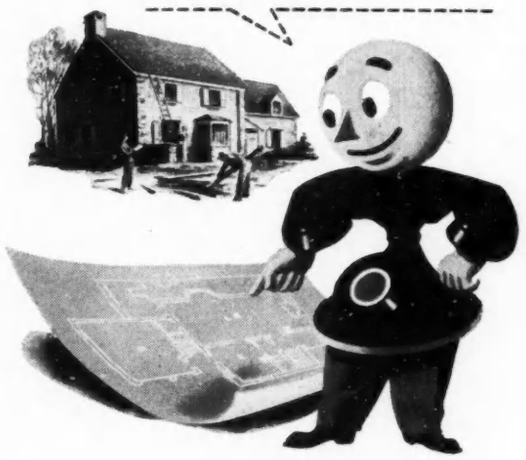
The story of concealed telephone wiring in homes is being told again. Now that new building and remodeling are getting under way it's important for every one concerned to know the value of advance planning for built-in telephone conduit and conveniently located outlets.

Telephone advertising is pointing this out to architects, builders and present and prospective home owners. On the opposite page are samples of our current trade and consumer advertising campaigns.

AN ADVERTISEMENT OF THE
BELL TELEPHONE SYSTEM

1 PAGE – TRADE MAGAZINES

"Why not make telephone conduit a part of every contract?"



Many electrical contractors are getting additional business on every residence job by including a bid for installing conduit for built-in telephone facilities.

Telephone conduit and outlets are easy to install during construction and they offer the home buyer real telephone convenience at little extra cost. More and more architects and builders are realizing that built-in telephone facilities help to sell the house. They are a sign of good planning.

By selling more architects and builders on this idea, you can increase your contracts and your profits.

• NO ELECTRICAL CONTRACT IS REALLY COMPLETE UNLESS IT INCLUDES CONDUIT FOR BUILT-IN TELEPHONE FACILITIES.

BELL TELEPHONE SYSTEM

The little things DO count

Attention to details is a basic secret of beauty and providing for concealed telephone wiring is one detail that can contribute effectively to the beauty of the home you are planning to build.

Don't let exposed telephone wiring mar the attractiveness of walls or woodwork. Telephone conduit, built into the walls of even the smaller homes, makes it possible to *conceal* the wiring and to provide convenient outlets for telephones.

The time is not far off when telephones will again be plentiful, so plan now for the telephone outlets you may some day need. Conduit to carry telephone wiring behind walls is inexpensive and easy to install during construction or remodeling.

Your Bell Telephone Company will be glad to help you plan your telephone facilities. Just call your Telephone Business Office.

BELL TELEPHONE SYSTEM

½ PAGE – CONSUMER MAGAZINES

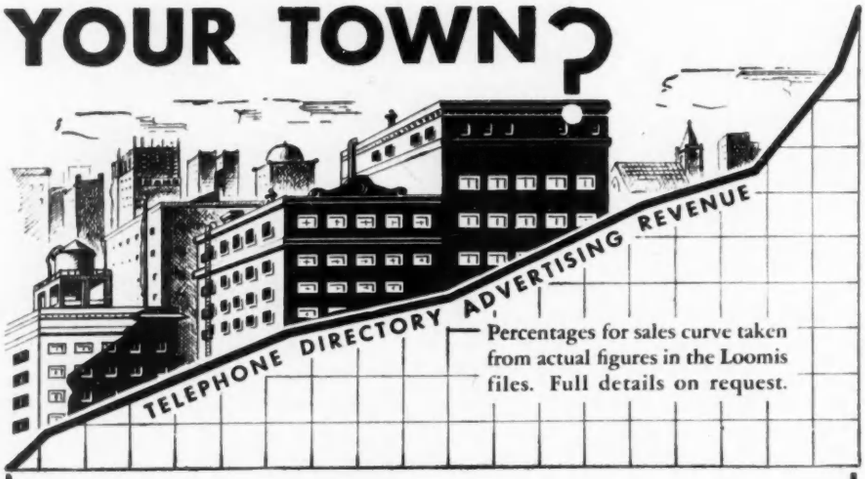
Acquires Property

The Mankato Citizens Telephone Company of Good Thunder, Minnesota received authorization from its state commission last month to acquire certain properties of the North East Farmers Telephone Company, Blue Earth County, Minn. and the Lyra Telephone Company of Good Thunder and Lyra townships, Minn. Present rates at Mankato's Good Thunder exchange became effective upon completion of the sales.

Complaint

The Public Service Commission of Utah recently ordered the Mountain States Telephone and Telegraph Company of Denver, Colorado, which furnishes telephone and telegraph service in Utah, to appear at a public hearing and investigation in respect to a just and proper rate base and a reasonable rate of return on such rate base. The Commission asserts that the company has been discriminating in rates, charges, tolls and service to various customers.

YOUR TOWN?


TELEPHONE DIRECTORY ADVERTISING REVENUE
Percentages for sales curve taken from actual figures in the Loomis files. Full details on request.

FORT WAYNE, Indiana is a city of 17.5 square miles, a population of 124,236 (1943 March census). Its Home Telephone and Telegraph Company's service includes 49,457 telephones as of Jan. 31, 1946.

In 1931, at the close of the brisk era of 1928, '29 and '30, with revenues then near their highest peak, the Loomis Advertising Company took over sales of Telephone Directory advertising . . . The July, 1945 advertising revenue was 235.4% of the December, 1930 income. Sales of advertising for the March, 1946 directory reach 275.9% of the 1930 figure.

No city is too large, no town too small for the application of Loomis "know-how" (22 years' experience, $28,000,000 in advertising). Whatever the size of your directory, the Loomis Advertising Company welcomes your inquiry. Roland T. Beard, Vice-President, 502 Gettle Bldg., Ft. Wayne, will be glad to discuss with you the sound, forthright methods that made this record possible.

Loomis ADVERTISING COMPANY

502 Gettle Bldg., Ft. Wayne 2, Ind.

506 Olive St., St. Louis 1, Mo. — 20 West 9th St. Bldg., Kansas City 6, Mo.
Omaha Nat'l Bldg., Omaha 2, Neb. — 6908 Market St., Upper Darby (Phila.) Pa.

USITA Executive Conference—Apr. 16-17

(Continued from page 35)

for the top managements of companies. If you, Mr. Executive, have made your hotel reservation and have received confirmation, be sure to take your written confirmation with you when you leave for Chicago. In order that accommodations may be available for the maximum number, please share your room with another if possible.

If you have not yet made request for a room reservation, you should do so without delay. If you have made a request but have been advised that it cannot be met because no room is available, it will be very hazardous for you to go to Chicago in the belief that you can somehow find a place to sleep. We strongly recommend that you do not make the trip if you do not have a confirmed room reservation.

For those who make their reservations early and are able to obtain accommodations the Executives Conference is going to be a great meeting with a fine program of outstanding speakers. The hotel corridors and rooms will abound in good fellowship.

Although there will be no telephone equipment exhibits at this conference, you may be sure that our friends, the manufacturers, will be on hand to discuss your supply problems with you and to lend you aid in their solution. They will also be available to participate in their traditional manner in the festivities of the occasion.

The date—April 16-17. The city—Chicago. The hotel—The Edgewater Beach.

9,000 New Rural Phones Plan of Illinois Bell

Installation of 9,000 telephones for new rural subscribers is the 1946 goal of the Illinois Bell Telephone Company. This increase would be the largest of any year in the company's history and would more than triple the extension of service made in 1945 to almost 3,000 rural subscribers. Field surveys of preferences of present customer's in rural areas are being used in this year's extension program. During the period from 1935 to 1945, rural telephone subscribers increased 150 per cent, while the total number of phones in Illinois was rising 54 per cent.

Exhibit of German Communications

Under arrangement now being completed, the Communications Unit of the Technical Industrial Intelligence Branch under the Department of Commerce Publications Board, of which John C. Green is executive secretary, will stage an exhibition of German communications and electronic equipment in Washington. Edwin Y. Webb, Jr., chief of the communications unit, reports that the exhibition, which may take place in the latter part of March in conjunction with a meeting of the Institute of Radio Engineers, will include "a vast amount of evacuated German communications equipment which will be of vital interest to American industry."

It was stated that some of the material for the TIIB demonstration is now being tested in the Signal Corps Laboratories and results of the tests will be given in information to be available at the exhibition through arrangement with Colonel W. C. Stecker, chief of the technical intelligence branch, intelligence division, office of the Chief Signal Officer.

It was emphasized that the communications equipment being sent from Germany to the TIIB covers every phase of the industry and examples of each would undoubtedly be included in the exhibition.

Vaughn Coe Rejoins A. B. Chance Co.

Vaughn Coe

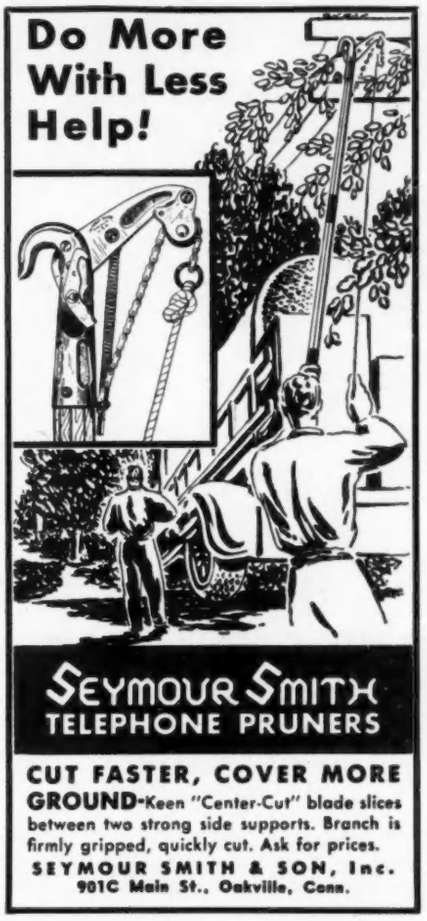
After three years in the Navy, Vaughn Coe, who has had thirteen years of service with the A. B. Chance Company, recently rejoined the company as district sales manager for the states of Nebraska, Kansas, Missouri, Oklahoma, and Arkansas.

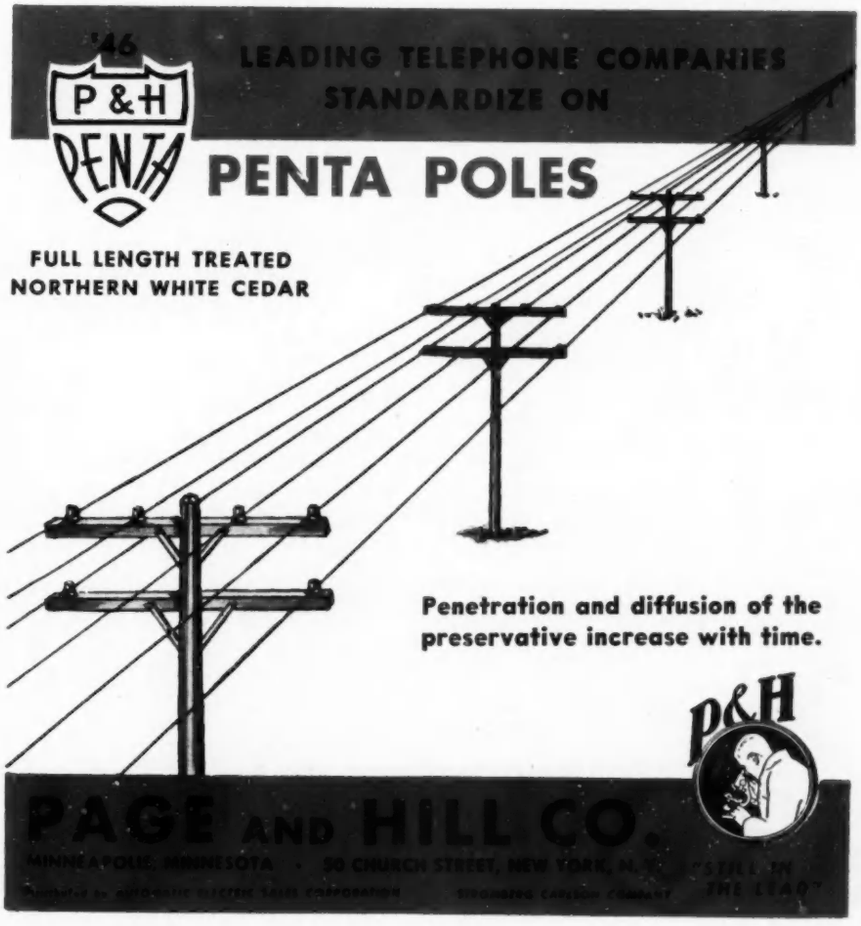
Mr. Coe's headquarters will be at the company's home office in Centralia, Missouri. Before entering the Navy, Mr. Coe represented the A. B. Chance Company with headquarters in Minneapolis.

Booklet on Radar

Western Electric Company has just issued an illustrated booklet on the role of Western Electric and the Bell Telephone Laboratories in the development of radar and how the solution of radar problems came through telephone research. The booklet brought out that Western Electric and Bell Laboratories, as the research and development arm, were the greatest single source of radar in war and that "this same team will be in the forefront of development and production of commercial radar in peace" which will be the key to safer, faster, more dependable transportation.

An interesting portion of the booklet dealt with the different phases of electronic tube research and production, wires and cables, radio and directional antennas, wave manipulation and circuit studies for telephone service which contributed to radar.


Do More With Less Help!
SEYMOUR SMITH
TELEPHONE PRUNERS
CUT FASTER, COVER MORE GROUND-Keen "Center-Cut" blade slices between two strong side supports. Branch is firmly gripped, quickly cut. Ask for prices.
SEYMOUR SMITH & SON, Inc.
901C Main St., Oakville, Conn.



You'll Find

SUB-CYCLE

Most Efficient for
RINGING SERVICE

Made in 6 Models for loads from Small PBX to Large Central Office. It's a "Static Type" frequency converter that produces ringing current without moving parts. Many exclusive features. Designed in accordance with sound engineering principles. Will deliver high efficiency for long periods of time without maintenance expense.

ALSO PULSATORS

Sold by Leading Distributors

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO

New Positions at Stromberg-Carlson

Frederic C. Young, vice president in charge of engineering and research of Stromberg-Carlson, announces a realignment of certain positions in their engineering and research division, made necessary by the rapid rate of the company's overall expansion.

Roger T. Furr was named chief technical service engineer in charge of the drafting and blueprint sections, the physical testing laboratory, the model shop, the standards and properties section, and the engineering procurement section. The instrument laboratory became a part of the research department under the direction of Benjamin Olney, director of research, while Howard H. Brauer, formerly in charge of the instrument laboratory, joined the company's engineering staff organization, assuming charge of the business phases of the division, including budgeting and scheduling. Oliver L. Angevine, Jr., was appointed chief sound equipment engineer in charge of the engineering department of the company's fast-growing sound equipment division.

Mr. Furr's experience with the company began in January 1944, when he was employed to head the radio drafting and blueprint department as engineer-in-charge. A native of Washington, D. C., he graduated as a mechanical engineer from George Washington University, class of 1929. From 1929 to 1941, he held the position of field engineer and supervising engineer for the Booth & Flinn Company. During the years 1930-1931, he was a resident engineer supervising the construction of Rochester's Veterans' Memorial Bridge. Early in 1941, he joined the U. S. Army Engineers in a civilian engineering capacity, in British Guiana. He was later made general superintendent of construction of the Army air base there.

Roger T. Furr

A native of Cincinnati, Ohio, Mr. Brauer attended local schools and the University of Cincinnati graduating from it as electrical engineer in the class of 1937. After graduate study at the University of Chicago, he began electrical engineering work.

Oliver L. Angevine, Jr.

THE GREATER THE PULL—
THE TIGHTER THEY GRIP

When You Use KEARNEY LAY-CIT CABLE GRIP

Lay-Cit Cable Grip is a neat compact grip that is easily and conveniently installed. Linemen can either take up or let out slack, by simply spreading the plates and adjusting the lacing.

They do not mar the insulation, and can be used over and over. Available in two sizes to handle cables from ⅜ to 1⅛ inch.

Now ready for IMMEDIATE DELIVERY. For complete information and prices see your regular jobber or write —

JAMES R. KEARNEY CORPORATION
4236 CLAYTON AVE. • ST. LOUIS 10, MO.
Overhead and Underground Utility Equipment

Howard H. Brauer

He was named to the post of development engineer in the Stromberg-Carlson instrument laboratory in July 1941, becoming engineer-in-charge September, 1944. He is a member of the Rochester Academy of Science, the American Institute of Electrical Engineers, and that organization's national instruments and measurements committee, the Institute of Radio Engineers, the Acoustical Society of America, Eta Kappa Nu and Tau Beta Pi, the national honorary engineering societies, and the Royal Astronomical Society of Canada.

Mr. Angevine, a native Rochesterian attended local schools and the Massachusetts Institute of Technology. His service with the company began shortly after his graduation in 1936 with the degree of Bachelor of Science in electrical engineering. Starting in the telephone laboratory, Mr. Angevine had risen by 1941 to the post of staff engineer assisting the vice-president in charge of engineering and research in problems involving planning and organization. He is chairman of the committee on sound systems of the engineering department of the Radio Manufacturers' Association, past chairman and the present executive committee member of the Rochester section of the Institute of Radio Engineers, past chairman and present executive committeeman of the Rochester Engineering Society, and the Technology Club of Rochester.

Rural Growth at N. Y. Telephone Co.

More than 8,100 new telephones serving farms and other rural residents were added by the New York Telephone Company during 1945, it was announced Feb. 15. This is the greatest rural growth for any year and brings the company's total telephones in rural areas in New York State to 110,000.

During 1946, as manpower and materials become available, the telephone company expects to add telephones in rural areas at an even faster rate. Its engineers report that in New York State the network of telephone pole lines is so extensive that more than 90 percent of the rural homes now without telephone service can be served without pole line construction cost to the applicants. Consequently, they state, the experiments which Bell System engineers are carying on with the REA and private power companies in sending telephone conversations over power lines will have greater value in other sections of the country than in New York State.

The company's program for modernizing telephone service in rural areas, interrupted by the war, was gradually resumed in the latter half of 1945. As a result all telephone customers in 46 of the company's exchange areas in the State had their service improved either by replacement of hand-crank telephones or a reduction in the maximum number of customers on any one line.

Multi-Lock

The anchor that was built to Suttle Specifications

Check These Features

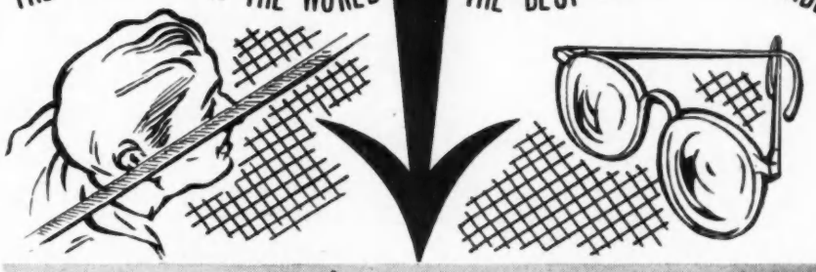
- ★ Largest expanded area per ounce of weight
- ★ Rib-braced in every direction—can't break
- ★ 4-step lock—can't slip
- ★ Simple—fool-proof
- ★ Curved plates claw into ground
- ★ Can't-slip nut holder

70" expanded area.....$1.34
56" expanded area..... 1.08

A Good Stock on HAND RIGHT NOW!

DEPEND ON SUTTLE

THE BEST EYES IN THE WORLD THE BEST GLASSES EVER MADE



. . . are not good enough to detect tension and sag to TODAY'S standards!

Be CERTAIN with a Dillon DYNAMOMETER

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CABLE—Aerial or underground, paper insulated, jute protected, 10-15-30-50-100-400 pairs, etc., submarine, single wire armor: WIRE—insulated, solid tinned copper inside, outside, color coded, twisted pair: TELEPHONE INSTRUMENTS—desk types, wall types, CB and dial, but less dial: MISCELLANEOUS—boards, test; spicers; binding post chambers.

Listings completely describing the material are now available at any RFC Regional Office. Ask for "WA Listing No. L-42, March 13, 1946," which contains detailed information about condition, location of items and how to obtain permission to inspect material at U. S. Signal Corps depot on and after March 20, 1946. This listing also contains an offer-to-purchase-form which must be used for the submission of all bids.

The equipment and parts are unpackaged (although some cable is on reels) but will be packaged after sale, when necessary, to insure safe shipment. All sales will be for cash unless credit terms have been arranged.

All bids must be delivered not later than 10 A. M. March 29, 1946, to the War Assets Corporation, 70 Pine Street, New York 5, N. Y., at which time bids will be publicly opened and read. The right is reserved to reject any or all bids.

VETERANS OF WORLD WAR II: To help you in purchasing surplus property from War Assets Corporation, a veterans' unit has been established in each of our Regional Offices.

For Further Information, Wire, Write, Telephone or Call at Address Above or at Any of the Regional Offices Below.

A DISPOSAL AGENCY DESIGNATED BY THE SURPLUS PROPERTY ADMINISTRATION for Surplus Producers' and Capital Goods, Aircraft and Plants formerly handled by Reconstruction Finance Corporation . . . and for Surplus Consumer Goods formerly handled by United States Department of Commerce.

WAR ASSETS CORPORATION

(A SUBSIDIARY OF RECONSTRUCTION FINANCE CORPORATION)

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411

New Owner

Frank T. Hampton is the new owner of the Robbinsville (N. Car.) Telephone Company as authorized by the North Carolina Utilities Commission. Present rates and charges remain in effect; however Mr. Hampton's plan is to improve both plant facilities and service. The exchange has 65 subscribers and was sold for $4,000.

Growth Without Profit Pacific Tel.'s Report

President N. R. Powley of the Pacific Telephone and Telegraph Co. in his annual report to the shareholders, issued Feb. 15, sounded the keynote that, even though his company, serving California, Washington, Oregon, Nevada and a portion of Idaho, had experienced exceptional growth throughout the war years, "our company did not profit from the war." Out of a $126,701,783 increase in operating revenues only $1,654,339 revenue betterment was carried to income available for interest and return and invested capital has so increased that the rate of return thereon was only 5.87% in 1945 compared with 6.33% in 1939 and the average for the entire war period was only 5.83%.

Mr. Powley reported that the estimated gross construction budget for this year will be more than $100 million and cited that the backlog of unfilled telephone orders as of last December 31 stood at 286,536. Of the 114,401 net gain in stations for 1945, 62% was made in the last four months of the year. The company had 2,702,686 telephones at the year-end and with 285 Independent connecting companies in its territory, there were 3,212,219 telephones on the Coast, a gain of 134,242 for the year.

Emphasizing that the Pacific Telephone & Telegraph Company and its subsidiaries are planning through the expansion to increase the plant investment by almost 50%, which will bring its total plant investment to an amount of around a billion dollars, Mr. Powley stated that "to do all the things we have in mind will take men, materials and money." The program will offer employment opportunities to many men and women not only in the manufacture, construction and installation of the added plant, but also in the maintenance and operation of a continuously improving and expanding service. He stated "our vast undertaking will require for its accomplishment earnings that are sufficient to attract the huge sums of new capital needed.

"The era of tremendous expansion," Mr. Powley stated, "that our company has now entered places responsibilities of the first magnitude upon our management. We go forward with a firm faith that a telephone service rendered well will continue to be well received. In our company following out its established policy—to furnish the best possible service; to render the service as economically as possible; to charge for the service only an amount to keep our company financially vigorous—it is of vital importance that its earnings be such that they will continue to attract the necessary amounts of new capital needed to accomplish these objectives.

"Earnings that are adequate are in the public interest, because earnings that are less than adequate necessarily jeopardize the efficiency and the scope of the service. Thus, our company and the public it serves have a common interest. In full recognition of that interest, the charges for the service rendered should reflect a fair treatment policy expressed in rates which, at all times, will be such that sound economic considerations will prevail in the interest of all parties—the patrons, the employees and the investors."

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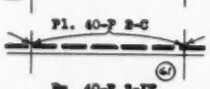
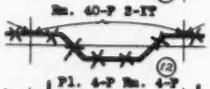
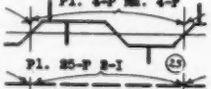
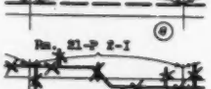
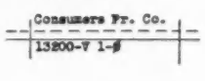
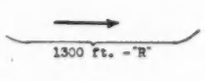
Telephone Engineer
HANDBOOK TABLES

Codes and Symbols for Toll and Rural Construction.

Index—Pole Line Design
Date—March 15, 1946

The illustrations in Table No. 2 below show how symbols for rural and toll line construction or repair appear on estimate sketches. The codes used in these illustrations are explained in Table No. 1 under the same subject (Handbook Tables for February 15, 1946).

***Table No. 2*—Codes and Symbols for Toll and Rural Construction**

	Present toll route.
	Proposed toll route (number encircled represents working mile number).
	Toll line to be entirely removed.
	Repairing present exchange line.
	Proposed exchange line.
	Exchange line to be entirely removed.
	Foreign pole line, showing ownership.
	Power transmission line, showing ownership, voltage and phase.
	Transposition section, indicating length, direction and transposition scheme used.
	Boundary of present farm line grouping scheme.
	Boundary of proposed farm line grouping scheme.

Meeting of USITA Executive Committee

A MEETING of the Executive Committee of the United States Independent Telephone Association was held February 28 in Chicago at which representatives of the five Independent equipment manufacturers were invited to discuss future requirements for the industry.

A statement of policy of the USITA is quoted later in this column.

Other matters on the agenda in addition to the discussion with manufacturers included consideration of the general service situation of the Independent telephone industry and measures which might be recommended to Independent companies to improve it. Developments in connection with continuity property record requirements were reviewed, also developments in connection with pending minimum wage legislation.

The general plans for the Executives Conference at the Edgewater Beach Hotel, Chicago, April 16-17 received attention and all plans were completed for this important meeting.

In regard to the National Convention to be held at the Hotel Stevens in October, the Convention Exhibit Committee reported space was not available for display of exhibits at this time.

Those attending the committee meeting were: F. M. Parsons, C. D. Manning, V. E. Chaney, Walter Dakin, R. W. Siemund, Floyd Ridings, A. N. Johns, Wesley M. Angle, R. A. Lumpkin, H. V. Bozell, T. S. Gary, F. E. Bohn, Clyde S. Bailey, F. R. McBerty, W. C. Henry, R. A. Phillips, and C. F. Mason.

Following is the statement of policy of the USITA adopted at the meeting.

A Definite Plan to Satisfy Held Telephone Orders in the Independent Telephone Industry at the Earliest Moment

The Executive Committee of the United States Independent Telephone Association has canvassed with the operating heads of the principal Independent telephone manufacturing companies the problem of satisfying the postwar demand for more and improved telephone service, and on Febuary 28 the Committee and the manufacturers joined in making the following unanimous statement.

During the past five years normal additions to plant and improvement in service were not possible due to prior requirements of the military. While at the same time the use of the telephone, both for local and long distance service, increased tremendously, shortages of manpower and materials together with problems of industry reconversion and labor difficulties have added to the delay. The seriousness of the situation impelled the policy-making Executive Committee of the United States Independent Telephone Association to take definite and constructive steps to solve this problem at the earliest date possible.

The manufacturers outlined their plans for a further increase in production, progressively over the months immediately ahead, in order to supply telephone instruments and central office equipment to Independent telephone companies. They pointed out that they had been placed at a temporary disadvantage by the sudden end of the war and called attention to the admonition of the Association's Postwar Planning Committee for adequate planning sufficiently far ahead for the requirements of operating telephone companies and the submission of such requirements to the manufacturers so that their factory operations could be geared to these requirements.

One of the bottlenecks in satisfying the huge backlog of held telephone orders is the necessity for outside plant construction, chiefly cable. The officers of the Association were instructed to confer with all cable manufacturers to obtain assurance that a proper proportion of the total production will be furnished Independent operating companies so as to assist in relieving this industry problem of deferred service. At the same time the attention of operating companies was called to the fact that several Independent manufacturers of cable are in a position to furnish cable on a more favorable delivery schedule than other manufacturers.

Officers of the Association were also authorized to contact the proper government officials charged with the responsibility of disposal of surplus telephone property to make sure that full information as to the needs of the Independent group is at hand when surplus material is being allocated.

The manufacturers assured the telephone operating executives that their production of telephone instruments would fully catch up with the demand within the next six months if telephone companies will cooperate in carrying out the following plan:

1. All operating companies are requested to review at once all orders which they have already placed for either telephones or central office equipment, and advise the manufacturers which of the items on order are required at once for the installation of held telephone orders or the relief of acute toll service overloads. On all pending orders for telephones or equipment which are not immediately required to satisfy held orders, specify a definite date in the future when the delivery of these orders will be required.

2. Operating companies are requested to order on separate purchase orders telephone instruments which are required to relieve held orders and to order for specific delivery dates only the number of instruments that can actually be installed within a thirty-day period. Note on the purchase order, "Required for satisfaction of current held telephone orders, and to be installed within thirty days of receipt." These orders will be given preference in shipment of telephones.

3. Operating companies are requested to order on separate purchase orders, the minimum amount of central office equipment that is required to relieve held telephone orders and that can be installed upon receipt. On these purchase orders also note, "Required for satisfaction of current held telephone orders and to be installed within thirty days of receipt." The manufacturers agreed that it was to the best interest of the industry as a whole to provide this equipment at the earliest possible date. To this end they further agreed that these orders would receive prior consideration in engineering and manufacturing.

4. Telephone companies should place orders with the manufacturers as soon

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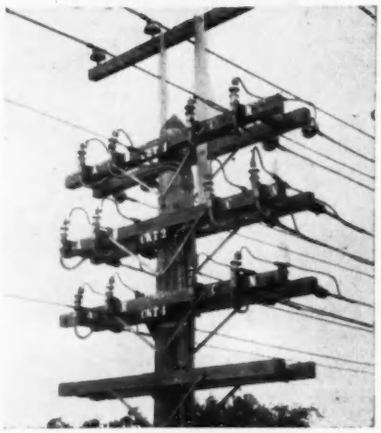

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as possible for telephone instruments required for change in type of service, improvements and future requirements, and should schedule these orders ahead at specific dates for shipment after held telephone order requirements have been met.

5. Telephone companies should place orders with the manufacturers as soon as possible for telephone central office equipment required for change in type of service or longer range additions and improvements, and schedule these orders for delivery as far ahead as easonably practicable, so that they can properly be set up in the manufacurers' production schedules.

6. Operating telephone companies should take pains to explain fully to their local communities their plans for improvements in telephone service and the probable date for completion of such improvements.

It must be pointed out that this serious service problem which faces operating telephone companies can be solved in the shortest period of time, and in fairness to all operating telephone companies, only by the complete cooperation of all segments of the Independent industry. Complete and accurate information must be furnished by the operating telephone companies to the manufacturers as to the urgency of station apparatus and central office equipment requirements.

The officers of the United States Independent Telephone Asociation are confident that with the cooperation of the Independent telephone operating companies and the manufacturers, the foregoing plan will relieve the existing backlog of telephone orders at the earliest moment, and will speed the day when company management can devote its entire efforts to expanding telephone service and taking full advantage of technological changes in the art.

W. J. Herrman Joins Commonwealth & Southern

Walter J. Herrman

Announcement has been made by J. R. Whiting, president of The Commonwealth & Southern Corporation, that W. J. Herrman, formerly vice-president of Telephone Bond and Share Company of Chicago, has joined the Commonwealth & Southern organization as rate analyst for the company and its subsidiaries.

An engineering graduate of the University of California in 1922, Mr. Herrman spent his first years after college with the Westinghouse Electric Company and the Great Western Power Co. of California. In 1933, he became a partner in the investment firm of H. R. Baker and Co. and as a result of this combination utility-financial background, was frequently employed as an expert witness on rate of return, cost of money and related subjects. In 1937 and 1938 he was called to Washington by the FCC to assist in the preparation of basic studies on rate of return in the telephone industry.

Subsequently, in his association with Telephone Bond & Share Company,

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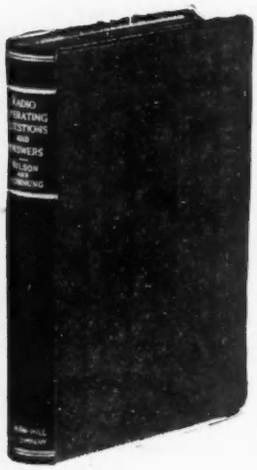

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2. Basic Theory and Practice (237 questions and answers)
3. Radiotelephone (213 questions and answers)
4. Advanced Radiotelephony (228 questions and answers)
5. Radiotelegraph (232 questions and answers)
6. Advanced Radiotelegraphy (225 questions and answers)

Appendix
I. Operating Abbreviations, Etc.
II. Rules Governing Commercial Radio Operators
III. Extracts from Radio Laws

Mr. Herrman was particularly active in resolving the long-standing controversies over Bell Company payments to the Independent carriers for terminal services rendered in handling joint toll calls. As a member of the Toll Committee of the U. S. Independent Telephone Association, Mr. Herrman shared the responsibility of obtaining broad revisions in the settlement contracts with the Bell System companies resulting in a redistribution of revenues in favor of the Independents amounting to several million dollars annually.

More recently, following Mr. Herrman's investigation of line-haul operations, the Toll Committee has been carrying on protracted negotiations with the Bell system looking toward a more equitable division of revenues from this source. These negotiations are now nearing a conclusion and are expected to bring further substantial benefits to the Independent industry. It is understood, in this connection, that Mr. Herrman will continue his service on the Toll Committee pending final settlement of this subject.

New Officers at Cook Electric

J. F. Jaap

John F. Jaap has been elected vice president of Cook Electric Company, Chicago. Well known throughout the telephone industry, Mr. Jaap has been with Cook for thirty-two years.

At the annual stockholders meeting recently, directors elected were: A. D. Edwards, G. P. Edwards, A. H. Edwards, W. C. Hasselhorn, J. S. Baker, C. E. Lundeen and K. M. Fiske.

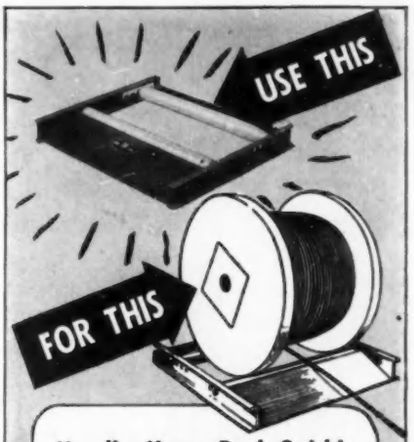
W. C. Hasselhorn was elected president of Cook Electric; J. S. Baker, 1st vice president; Mr. Jaap, 2nd vice president; C. E. Lundeen, secretary-treasurer; C. Ruth, asst. secretary; and K. E. Gundersen, asst. treasurer.

Surplus Equipment Report

Declaring that existing procedures for disposal of surplus communications equipment "are not wholly adequate" and that the handling and merchandising problems within this field are "of great complexity," the War Assets Corporation on Feb. 20 presented an interim report to Congress covering present surplus of telecommunications equipment as well as anticipated surplus for the first half of 1946.

In recapitulation of the report, anticipated declarations for telephone and telegraph surplus equipment for the "near future," were estimated at $35 million with $11 million already turned over to the WAC.

The figures given by the WAC were estimates of the cost of the various types of equipment to the government, of course, and it was indicated by the report that only a small percentage of the total cost is expected from surplus sales. It was emphasized that much of the equipment will consist of items of special character but "not readily adaptable to peacetime use" and will be suitable only for salvage or scrap.



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Edited By
J. S. REED, JR.

LINE and DESK

Q. What is the construction of the elecrolytic condenser that causes it to have such a high capacity in spite of its small dimensions?

A. The electrolytic condenser consists of two aluminum plates immersed in an electrolyte of ammonia, boric acid and water. One of the plates, the positive anode, has an oxide film formed over its surface when direct current is applied to the terminals of the condenser. This film has the property of offering very high resistance to the flow of direct current. when the current is in one direction. The film is extremely thin, ranging from 0.00004 to 0.000004 inches in thickness, depending on the voltage at which the film was originally formed. Since the capacitance of a condenser is inversely proportional to the thickness of its dielectric, the capacitance of an electrolytic condenser is very high. For example, if the area of the oxide film is 2" x 4" on each side of the anode, resulting in a total dielectric area of 16 square inches and the film is 0.000004" thick, the capacitance would be approximately 10 mf. It is possible to build condensers of this type having as much as 2000 mf. capacitance, and yet measuring only 1½" in diameter and 4" long.

Q. We repair quite a number of switchboard cords every so often and find it a difficult and tedious task to satisfactorily polish plugs that are taken off the cords. What method would you recommend for polishing the plugs quickly and easily?

A. We suggest that you use an ordinary low power buffing motor for polishing the plugs. Equip the motor shaft with a drill chuck. Clamp the butt end of a worn-out plug in the chuck and slip a piece of rubber tubing over the tip end. Place a little plug polish on a square of absorbent cloth and holding the tip end of the plug inside the cloth, insert the butt of the plug over the rubber tip. When the motor is turned on, the rotating tip will screw itself inside the butt and firmly grasp the plug during the polishing operation. Move cloth along the plug, using the thumb nail to work the cloth into the contours at the tip, dead collar, ring and sleeve. Repeat the operation with a clean part of a cloth until a bright polish is obtained. Then stop the motor and pull the plug off the rubber tip. It will come off quite easily, and you then can insert another plug for the polishing operation.

Q. How can corrosion of ground wire connection to a ground rod be prevented when a clamp is used to make the connection?

A. It is generally the better practice to solder the ground wire connection to a ground rod, or else use a rod with soldered copper wire tail that can be connected to the ground wire by means of a compression or twist sleeve. However, if you find it necessary to make the connection by means of a clamp be sure the rod and clamp are thoroughly clean and bright, and that the connection is tight. Apply pure vaseline over the clamp and rod to prevent corrosion at this place.

Q. Would you give me the constructional details on a cableman's sleeve opening tool that was recently described in your column?

A. Figure 1 illustrates construction of a cableman's sleeve opening tool. You will note that this tool is made in three sizes, one for cable sleeve of 1 to 1½ inches in diameter, the second for sleeves 2 to 3½ inches in diameter, and the third for sleeves 4 inches in diameter or larger. The illustration shows the small size tool. The larger tools have wider blades in proportion to their size in order that the cable sleeve will not be damaged by using a tool with a narrow blade.

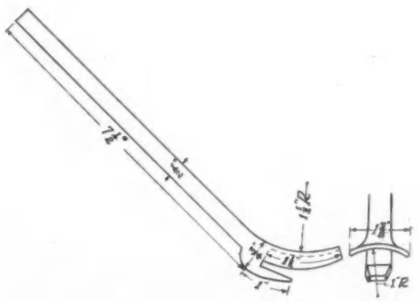

Fig. 1—Showing constructional details of sleeve opening tool (Formed from ½" wrought iron rod with 3/32" steel plate shaped to form blade and welded to rod).

Harold Jester Returns to Leich Sales

Harold J. Jester, recently released from the Army Air Forces, is once again with Leich Sales Corporation. Mr. Jester represented the Leich organization in the state of Iowa for five years previous to his enlistment in the Army Air Forces Reserve in 1942.

Mr. Jester was called to active duty in August, 1943 and upon completion of basic training was sent to Air Force Weather School.

Harold Jester

He spent 15 months as a weather observer in the Panama Canal Zone and in the interior of the Republic of Panama. Just previous to his discharge, Mr. Jester had been transferred to the headquarters staff of the 8th Weather Group, Army Air Forces, at Grenier Field, New Hampshire.

For the time being, Mr. Jester will be in Leich's Chicago office.

International Harvester Adds Research Project

Establishment in Chicago of a manufacturing research project devoted to the improvement of manufacturing methods and procedures for the entire line of International Harvester Company products, was announced in early March by K. O. Schreiber, vice president in charge of manufacturing. The company's manufacturing research activities will be carried on in the plant operated during the war by Foote Bros. Gear & Machine Corp. for the manufacture of aviation parts, 5225 South Western Avenue. The Harvester project will occupy about 230,000 square feet of floor space and the company will invest a substantial sum of money in the improvement of the property and in the procurement of necessary equipment and facilities.

Mr. Schreiber pointed out that the new Harvester establishment will not be a general research laboratory but rather will be a specialized center for intensive study of improved manufacturing processes; nor will it replace the already substantial amount of manufacturing research going on at individual Harvester plants. Rather, it will supplement such plant research.

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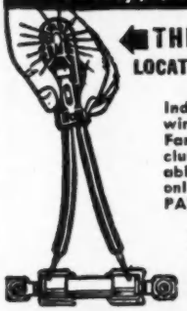

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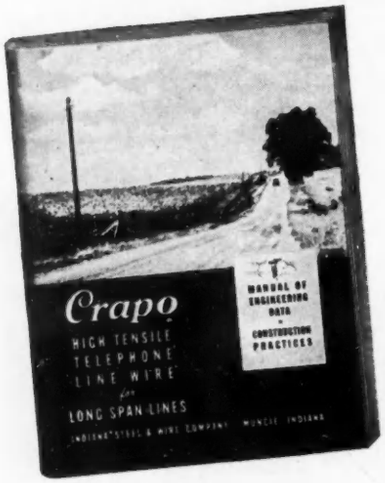

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